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THE HISTORY OF ANAESTHESIA SOCIETY PROCEEDINGS

Vol 20

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Westminster, 16th January 1997.
Held jointly with
The Association of Anaesthetists of Great Britain and Ireland
The Sections of Anaesthesia and History of Medicine of
the Royal Society Of Medicine

Includes cumulative index Vols 1 - 20

Sesquicentennial Meeting - January 1997

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Editorial

Publication of the 20th volume of our Proceedings calls for some celebration, and it is most fitting that this issue records the splendid Sesquicentennial Meeting, hosted jointly by the Association of Anaesthetists of Great Britain and Ireland, the History of Anaesthesia Society, and the Sections of Anaesthesia and of the History of Medicine of the Royal Society of Medicine. The programme was worthy of the occasion, thanks to David Wilkinson, his organising committee and to the erudite speakers they assembled. Outside the lecture hall there was much interest in the panel display 'From Letheon to the Laryngeal Mask' devised by Tim Smith of Reading, the Association archive films shown by Ian McLellan and the operating table from University College Hospital used by Robert Liston for his first amputation under ether anaesthesia. Delegates were also surprised and delighted to find in their brief-case a reproduction of Allen & Hanburys' 1938 Catalogue of anaesthetic and surgical equipment - the Sesquicentennial gift of Sir Anthony Jephcott, one of our founder members. Many delegates joined their partners next day for two fascinating medical history tours of London, with the dynamic Sue Weir as their knowledgeable guide. A remarkable number stayed on to attend the Celebratory Dinner at the Dorchester.

It was particularly pleasing to see so many international figures among the 300 who attended this 150th anniversary, and to have John Severinghaus inducted as an Honorary Member of the History of Anaesthesia Society. Professor Jiri Pokorný and his wife came from the Czech Republic, and it is a pleasure to include in this volume a report of the successful Sesquicentennial meeting held in Prague. It also seemed appropriate to have a brief account of the Sesquicentenary Meeting in Dumfries, kindly provided in her inimitable style by Aileen Adams.

This opportunity has also been taken to produce an index of our first 20 volumes. The time-consuming task of indexing has been entirely the work of Publication Coordinator and Council Member Frank Bennetts, with his assistant Margaret Micklewright. Members should be aware of the major contributions made by this team, and of the unswerving support of Abbott Laboratories, from the start of publication. The growth of the HAS since its inception in 1986 has been a story of success, and the Society is proud to have been part of anaesthesia's 150th anniversary celebrations. Within our various organisations, all were happy that the Sesquicentenary events were so entertaining and successful. But what an opportunity was lost in the wider context. Where was the media coverage of a most newsworthy occasion? In PR techniques, in feeding the right releases, photographs and news opportunities to press, radio and TV journalists, we are obviously sadly deficient. Further education is needed, not only in anaesthetics history, but in the promotion of our specialty.

AMB

ETHER AND CHLOROFORM - THE FIRST 20 YEARS

Westminster, Thursday, 16th January 1997

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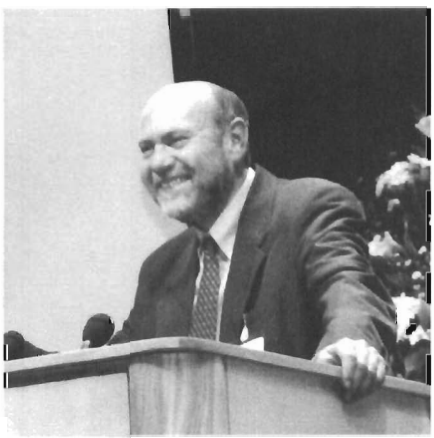

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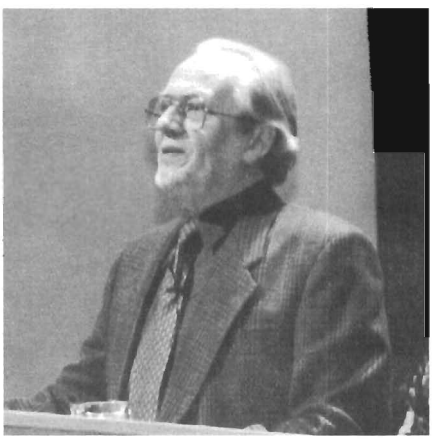

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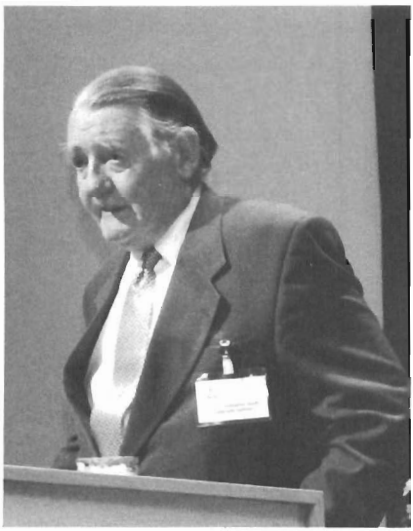
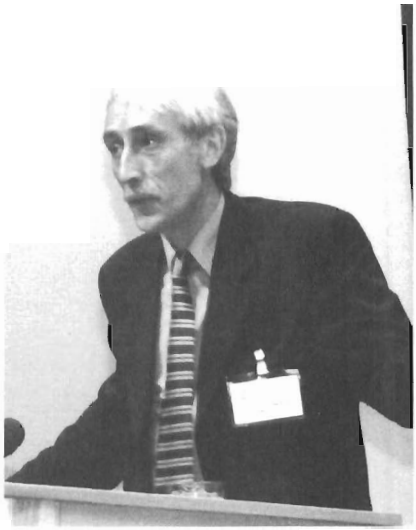


Sir Christopher Booth



Prof A R Aitkenhead

Dr R S Atkinson, President HAS confers Honorary Membership on Dr J Severinghaus

PROCEEDINGS OF THE HISTORY OF ANAESTHESIA SOCIETY

Volume 20

Papers presented at the joint one day celebration of 150 years of the use of ether and chloroform in anaesthesia. London, 16th January 1997.

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ANAESTHESIA IN THE AGE OF REFORM*

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Striking reforms and innovations frame the first use of inhalation anaesthesia in Britain by Robert Liston in December 1846. In nearly all of these reforms, science, the Evangelicals and the Benthamites** (as typifying rational reformers) played a large part. Here I pursue the ways in which these three elements figured in the introduction of anaesthesia into Britain. A few landmark events testify to Evangelical and Benthamite persuasive power in these years. Eighteen thirty-three saw the abolition of slavery; a triumph for the Evangelicals, and ironically, it was the year of the death of William Wilberforce, aged 59. The very next year, 1834, witnessed another major reform; the introduction of the new Poor Law.

This latter by contrast marked the triumph of Edwin Chadwick and the Benthamites and, equally ironically, it was the year of the death of Thomas Malthus aged 66, whose presence and spectre haunted the poor throughout the century. Eighteen forty-two saw Ashley's Act on the employment of children in mines, an Evangelically inspired reform. The year also witnessed the publication of Chadwick's monumental Report on the Sanitary Conditions of the Labouring Poor. Other equally portentous events stand on the other side of Liston's operation. Eighteen forty-eight, the year after chloroform's introduction, included two reforms that neatly symbolise the relation of anaesthesia to its age. First the demolition of the ancient Fleet Prison, an institution that, for Victorian reformers, and for Evangelicals particularly, stood for everything that was corrupt, degrading and brutal in 18th century life. Second, the great Public Health Act, a Benthamite triumph and almost the first acknowledgement by Westminster that the health of the nation's citizens might be more important than private interest.

Here then, in the 1830s and 1840s, were a few of the many momentous events surrounding a single, perhaps at the time, relatively unimportant occasion in University College Hospital. What was the connection? What were the factors and forces mediating between reform on the world stage where the Evangelicals and the Benthamites acted, and the hospital theatre in which Liston performed the first operation under anaesthesia in Britain.

The first and most obvious of these mediators of course was science and medicine. If we take two scientific events of the 1840s, Michael Faraday's work on electromagnetism and the

* Parts of this paper are to appear in: Christopher Lawrence. Medical Minds, Surgical Bodies; Corporality and the Doctors. In: Christopher Lawrence and Steven Shapin, eds. *Science Incarnate; Historical Studies of Embodied Knowledge*. Chicago: University of Chicago Press, forthcoming. I am grateful to the Press for permission to publish them here.

** The disciples of the philosopher Jeremy Bentham(1748-1832) founder of Utilitarianism, a philosophy predicated on using the legislature as a source of rational social change as opposed to seeing it as the embodiment of tradition

publication of Robert Chambers' notorious *Vestiges of the Natural History of Creation*, we can see in these things the Victorians' faith in progress and their belief that through science and technology there would be alleviation of the human condition. Witness the very non-evangelical, non-Benthamite John Henry Newman writing in mid-century: 'Virtue is the child of Knowledge: Vice of Ignorance: therefore education, periodical literature, railroad travelling, ventilation, and the arts of life, when fully carried out, serve to make a population moral and happy'.[1]

That the technology of ventilation might serve to make a population 'moral and happy' might seem now a judgement blessed with a certain naiveté, but Newman was here drawing on deep metaphorical and material experiences of the role of the atmospheric circulation in the regulation of social life. Eighteenth-century prison reformers such as John Howard and medical advocates of military and naval reform, such as Sir John Pringle or Gilbert Blane, found in damp airless gaols or between the decks of Royal Naval ships, a morally depraved underclass, needing diet, cleanliness and better ventilation to make them moral and disciplined. A key resource deployed to bring about this improvement was the new gas chemistry. The isolation of fixed air, hydrogen, nitrous oxide, nitrogen, oxygen and so on by Joseph Black, Henry Cavendish, Joseph Priestley, Antoine Lavoisier and others, was not a restricted scientific exercise, but part of a programme of social and moral reform. This is evidenced, by, for example, Joseph Priestley's attempts to use James Cook's voyages as experiments to test the power of cleanliness, discipline and fixed air to cure scurvy.

Gas chemistry, the fundamental prelude to modern anaesthesia, was deeply embedded in the Enlightenment vision of progress. Enlightenment thinkers invested heavily in medicine as an agency that could bring about that progress. Medicine was conceived of as a means to alleviate individual sickness but at the same time as an agency that could be used to effect reform and maintain social order - the continental phrase 'medical police' is pertinent here. It is this context that makes it possible to situate Humphry Davy's famous conjecture: 'As nitrous oxide in its extensive operation appears capable of destroying physical pain, it may probably be used with advantage during surgical operations in which no great effusion of blood takes place.'[2] A salubrious atmospheric economy was as important to Edwin Chadwick's vision of the public health as inhalation therapy was to many medical reformers.

Davy's words point to another mediating factor between the world at large and that moment of 1846: surgery itself. Since the early modern period, physicians have been seen as grave, scholarly, learned gentlemen, but surgeons have had to struggle to identify themselves and have erected boundaries to separate themselves from undesirable association with more menial manual workers and users of instruments. Surgeons liked to present themselves as robust, practical folk, but they also had to differentiate themselves from the trades of, for example, barbering and, even worse, butchery.

An association between meat eating and intellectual coarseness has been made since antiquity and the view remained quite common until the 19th century. In *Twelfth Night* Sir Andrew Aguecheek observes 'I am a great eater of beef and I believe that does harm to my wit'. One 18th century observer noted 'Vulgar and uninformed men, when pampered with a variety of animal food, are much more choleric, fierce and cruel in their tempers than those who live chiefly on vegetables'. Likewise the slaughtering of animals was viewed as predisposing to human cruelty. In Sir Thomas More's *Utopia* of 1516, slaves did the slaughtering. In Britain,

butchery was regarded by many as a thoroughly offensive and degrading trade. In Joshua Poole's *The English Parnassus* of 1677, butchers were described as 'greasy, bloody, slaughtering, merciless, pitiless, cruel, rude, grim, harsh, stern, ... surly'. 'The trade of a butcher,' said Adam Smith, 'is a brutal and an odious business'.[3]

The association of surgeons with butchers goes back at least to the Middle Ages when Henry de Mondeville declared that surgeons, like other specialists in flesh, must 'boldly cut and destroy'.[4] In 1665 George Thomas observed that 'we know .... that Surgeon[s] are too forward to lop off parts, and butcherly to cut holes in the skin'. In 1787 Lord Herbert expostulated: 'Never for God's sake see a d-------d Doctor' after he had done with the services of 'butcher Pott' - Percival Pott was, of course, a surgeon. In 1813, the satirist, Peter MacFlogg'em, recommended that the surgeon acquire 'the unfeeling *brutality* of a butcher' and noted that, if in a head injury there seemed to be a deficit of brains, 'you may procure enough of this article, to supply the melancholy defect, from some neighbouring *brother butcher*'.

I have used the word surgeon thus far as though it designated a member of a single occupational group. But of course, it did not. In the second half of the 18th century in London, Dublin, Edinburgh and the great continental cities, small numbers of highly skilled, learned practitioners, lumped with country doctors by the caricaturists, were endeavouring to elevate themselves and their craft onto, and indeed above, the social plane occupied by physicians. One of the ways in which they did this was by creating a new general pathology applicable both to external diseases traditionally treated by surgeons and internal diseases traditionally treated by physicians. At the turn of the 18th and 19th century surgeons, notably French surgeons, gradually redefined the interior of the body as their rightful domain. At the same time they were increasing their technical expertise. It is quite clear that, regardless of the introduction of anaesthesia, early 19th century surgeons were expanding their operative skills without the use of an anaesthetic. During the first half of the 19th century surgeons (increasingly American surgeons) created a range of complicated operations, many of which required a protracted period at the operating bench. These included ligature of major blood vessels, operations on ankylosed joints (including hips), the extension of trepanation to diseases such as epilepsy, amputation in non-life threatening conditions, excision of diseased bones and joints, excision of the upper or lower jaw, oesophagectomy and amputation of the tongue. Surgeons of the time increasingly began to designate their era as one of 'conservative surgery'. Conservative meant, however, not limited surgical intervention, but preservative; an early operation now saved tissue from excision later. A complicated operation of joint resection today saved the patient from heroic amputation tomorrow. Such complicated operations, however, took time. The conclusion seems inescapable; early 19th century surgeons were making their assault on the body with or without pain relief or, put less crudely, by the 1840s so great was the determination to invade that, in retrospect, the invention of technologies to facilitate this invasion seems inevitable. As the distinguished historian of medicine Henry Sigerist put it: 'surgery became great, not because anaesthesia and antisepsis were introduced, but anaesthesia and antisepsis were found because surgery was to become great; because surgery was the anatomical method of therapy'.[5]

But equally importantly, as surgeons made surgery as estimable as physic, so they climbed higher in social esteem. Two things made this possible. First, surgeons displayed surgery as a profession based on learning; the learning in this case being largely experimental science.

One measure of the surgeons' adoption of learning was the abandonment of the language of butchery in favour of a technical vocabulary, for example, the sweetbread began to be called the pancreas. Second, surgeons began to present their scientifically-principled art as something suitably practised by gentlemen. Surgery was a significant site where gentility was redefined in professional terms.

That surgeons had used science to make themselves into gentlemen was well recognized in the 19th century. Of John Hunter, widely regarded in 19th century Britain as the 'founder of scientific surgery', James Paget noted:

> 'And now mark what he did for surgeons. Before his time they held inferior rank in the profession ..... they were subject to the physicians and very justly so, for the physicians were not only better learned in their own proper calling, but men of higher culture, educated gentlemen and the associates of gentlemen. From Hunter's time a marked change may be seen. Physicians worthily maintained their rank, as they do now, and surgeons rose to it, ... Yes, more than any man that ever lived, Hunter helped to make us gentlemen .... Surely, that if we are to maintain the rank of gentlemen ..... it must be by the highest scientific culture to which we can attain.'[6]

In this respect, surgeons were just one of a number of groups of gentlemanly scientific experts - a Benthamite notion - appearing in the early 19th century. Chemists and economists are others that come to mind. Edwin Chadwick, once Jeremy Bentham's secretary, who brought science to bear on society's problems, was the quintessence of such an expert. But early 19th century surgeons had more to their image than this. In creating themselves as learned gentlemen-practitioners, surgeons did not simply appropriate the image of the physician and appear bookish, lean, grave, and scholarly. Far from it; they remodelled their traditional image. The robust practicality which surgeons had long attributed to themselves had been an object of satire in the 18th century and was easily caricatured as clumsiness and stupidity. As we have also seen, one means to denigrate the surgeon was to call him a butcher. But, by the end of the 18th century, the butcher himself, in some contexts, had come to represent common sense and the liberty-loving Englishman. 'His work', contemporaries said, ' required skill, strength and lack of squeamishness'; he was typically thought of in the 18th century as both bold and extremely amorous. Butchers were portrayed as heroes because they 'presided over the preparation and sale of that most distinctive of English dishes, the roast beef of England'. The butcher personified virility and was a 'reminder of English prosperity'.[7] Eighteenth-century caricaturists contrasted aristocratic effeminacy and the masculine, unaffected directness of the demotic butcher.

It was the sorts of qualities embodied in the butcher - a capacity for physical endurance, courage, solidity and honesty, which were highly prized in the Victorian cult of manliness. Butchers were hardly candidates for the Victorian manly ideal, whereas surgeons, increasingly accepted as gentlemen, were. By the 1840s British and American surgeons were presenting themselves as the embodiment of heroism and manliness.[8] In 1887, Lawson Tait noted of Robert Liston, the same Robert Liston of anaesthesia fame: 'We always spoke of him as a hero'. American surgeons of the 19th century and beyond, likened themselves to frontiersmen. As Frederick Dennis put it:

> 'There is no science that calls for greater fearlessness, courage, and nerve than that of surgery, none that demands more of self-reliance, principle, independence and the determination in the man. These were the characteristics which were chiefly conspicuous in the early settlers of this country. And it is these old-time Puritan qualities, which, descending to them in succeeding generations, have passed into surgeons of America, giving them boldness in their art, and enabling them to win that success in surgery, which now commands the admiration of the civilized world.'

The Victorian cult of manliness which was visible in imperial conquest and on the playing fields of Rugby later in the century had had its origins in Evangelicalism, a cult in which praise of the masculine virtues of earnestness, integrity and selflessness prevailed. Victorian surgery inherited as much from Evangelicism as it did from John Hunter and Enlightenment rationalism.

It is to Evangelicism too, in part, we must turn to understand the Victorian war on cruelty, slavery, bull-baiting and unnecessary pain and suffering. Evangelicism was associated with a new attitude to pain and suffering; one that fostered the introduction of anaesthesia. Evangelicalism was, I suggest, a sort of dual stimulus to the introduction of anaesthesia; on the one hand it indirectly fostered surgical boldness, itself a stimulus to the employment of anaesthetics, and it also fostered the introduction of anaesthesia as a source of benefit for the patient.

Evangelicals did not desire the abolition of *all* pain and suffering; certainly not what they saw as necessary pain and suffering - the pain which was the consequence of the fall, the pain necessary for redemption. In this sense, Evangelicism was also the source of resistance to anaesthesia, especially in labour, perceived as part of the lot of fallen woman. In almost every respect, except this last, Evangelical views on unnecessary pain were identical to those of that other great group of reformers the Benthamites, although for quite different reasons.

It is noteworthy, and not coincidental, that two areas in which pain has a high social profile - medicine and the law - saw a transformation of attitudes in the Victorian era, and in both Evangelicalism and Benthamism were at work. The law and medicine, of course, had much in common, for both in this period were centrally preoccupied with the issue of self-control, the loss of which could lead to crime, madness or ill-health. The creation of new forms of discipline was deeply entwined with reform, whether of the legal code or public health administration. The early 19th century disgust with Georgian violent punishment was born of both a genuine repugnance for physical force and a deeply rooted sentiment that it worked against the civilising process. Gradually during the 19th century, flogging and other gross forms of punishment were phased out. Instead the prison promised moral reform. Punishment and pain, for those who deserved it, were recast as isolation and loss of liberty. Moral pain replaced physical suffering. Behind these reforms lay the ostensibly very different reforming engines of Evangelicism and Benthamism with their shared sentiment about unnecessary suffering. This was another impulse, I think, which led to the introduction of anaesthesia. When the pain of an operation could seem unnecessary or undeserved, when it had no place in the moral order, then the impulse to abolish it was acted on.

I suggest then, that the introduction of anaesthesia in the 1840s was not a fortuitous event. It required not simply gas chemistry, nor merely the rise of surgery, although of course these two things were the absolute preconditions. Anaesthesia's introduction was shaped by Benthamism and Evangelicism, movements which were equally at work, in their own fashion, in North East America. These great reforming forces shaped not only surgery - as a profession for gentlemanly experts and Christian heroes - but shaped an age's attitude to the poor and to pain. Anaesthesia was deeply embedded in the age of reform.

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SPREADING THE NEWS

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From Boston to London

October 16th 1846 is usually regarded as the day when the medical profession became convinced that the goal of painless surgery was in sight. In the Massachusetts General Hospital, Boston, the dentist William Thomas Green Morton gave ether by inhalation to Gilbert Abbott for an operation on a tumour of his neck. The surgeon was John Collins Warren, senior surgeon at the hospital. Like most great advances it was not an isolated event but rather the culmination of many previous events. As Lawrence wrote in 1987:[1]

> 'It is no more possible to say who discovered anaesthesia, or where or when, than to find a moment when oxygen was discovered or cells were first described.'

If we wished to be partisan, we might claim as our starting point England in the year 1800 with Humphry Davy's prediction:[2]

> 'As nitrous oxide appears capable of destroying physical pain, it may probably be used with advantage during surgical operations...'

This meeting celebrates the first British and, indeed, European anaesthetics given on 19 December 1846 a few weeks after Morton's Boston demonstration and my task is to look at how this news came to Britain, how it spread throughout the country and what transpired during the first twenty years of its development. Those present at Morton's demonstration on 16 October surely felt a mission to spread this news widely. The key figure was not Morton the anaesthetist, nor Warren the surgeon, who were both busy with other activities: it was a physician.

The Bigelows

Jacob Bigelow was a leading physician in Boston, but also a distinguished botanist with international connections and this was to prove important. His son, Henry, a young surgeon, watched Morton's demonstration. It was Henry who spread the news widely throughout Boston, both to the medical profession and to the lay public. He reported it at medical meetings and published an article in the *Boston Medical and Surgical Journal*[3] which was reprinted in full in the local newspaper, the *Boston Daily Advertiser*, on 19 November, just over four weeks after Morton's demonstration.

Jacob Bigelow was in regular contact with an old friend from his student days, Dr Francis Boott, now living in London. Boott had settled in Britain some years before and had studied medicine in Edinburgh, but his main interest was botany.[4] He was thus an obvious point of contact for Jacob Bigelow, whose enthusiasm had been increased because his own daughter had had a tooth extracted under ether. On 28 November he wrote to Boott and sent him a copy of his son's article in the *Boston Advertiser*.

The letter

Mail could travel to England from Boston either by sailing vessel or by Samuel Cunard's new steamship. Bigelow chose to send his package via the latter, no doubt because it was faster. The next boat to leave Boston was the paddle steamer *Acadia* which sailed on 3 December. She stopped at Halifax to refuel, and docked at Liverpool at 9 am on 16 December, a day late as the weather had been poor. The mails were unloaded and the London packages sent by rail from Lime Street Station in Liverpool to Euston, taking 12 hours for the 210 miles. Thence it was 2 miles by horse-drawn cart to the General Post Office in central London. It was received by Dr Boott at his residence in Gower Street on 17 December, the day after the *Acadia* docked.[5,6]

This was not, in fact, the first information about ether anaesthesia to reach England. At least seventeen earlier letters have been traced,[7] but as none of these triggered the clinical use of ether in the United Kingdom I shall say no more about them.

Francis Boott was clearly impressed by Bigelow's letter. Immediately, he did three things: he sent a copy of the letter with the newspaper article to the editor of the *Lancet*, he notified Robert Liston, Professor of Surgery at University College Hospital (UCH), and he obtained some sulphuric ether and arranged with his dentist neighbour James Robinson to use it on a patient.

James Robinson

James Robinson, like Boott, was a talented man and far ahead of his time. He led the movement to professionalise dentistry and raise its standards from near-quackery to respectability. That he became a pioneer of anaesthesia is therefore not surprising, he was that sort of man. He and Boott made themselves a vaporiser based on an apparatus used for the manufacture of soda water. After briefly trying it out, Robinson administered ether to a Miss Lonsdale on 19 December for removal of an impacted molar tooth, a procedure she proclaimed to be completely painless.[8]

Robinson was enthusiastic, and continued to use ether, gaining the reputation as the most skilful etheriser in the country. As early as February 1947 he published his *Treatise on The Inhalation of the Vapour of Ether*, the first textbook of anaesthesia ever written. Yet his career as an anaesthetist lasted barely four months after which he returned to his mission to upgrade dental practice.[9]

Robert Liston

Professor Liston wasted no time either. He sent for his medical student, William Squire, who has described what they did. Squire already knew about the effects of ether and nitrous oxide, having inhaled both of them in chemistry classes at medical school. He distinctly remembered having knocked his knuckles and feeling no pain. Liston and Squire went together to Robinson's house to see ether used, and Liston was impressed. It so happened that William Squire's uncle, Peter, was a chemist who had a laboratory in Oxford Street, so the two of them went straight there to seek his help. Peter Squire rigged up a vaporiser and they tried out ether on his assistant, John Taylor, who inhaled it to the point of unconsciousness

and awoke to find his fingers bleeding from the pinpricks they had inflicted whilst he was asleep. The two Squires continued to experiment over the weekend on themselves and other volunteers until Liston was convinced it was worth trying on a patient.

On Monday, 21 December, in UCH in a theatre full of eminent medical men, Liston prepared to do an amputation. He told his audience that they were going to try something quite new and asked them please to keep quiet. The Squires administered ether to the patient, Frederick Churchill, who took it smoothly and showed no reaction at all to the amputation of his leg. He woke up shouting: 'Take me away - I cannot have it off', quite unaware that it was all over. The experiment had been totally successful.[10] Although Liston was the first in this country to use ether in public, it is surely right to describe the dentist Robinson as the true pioneer of anaesthesia in Britain. He was the first to use it and it was he who stimulated Liston to do the same.

From Boston to Dumfries

We must now return to Liverpool, because something else was happening after the *Acadia* arrived from Boston. The ship's doctor on the *Acadia* was a Scotsman, William Fraser, who also knew about Morton's discovery. He hastened north to his home in Dumfries where he persuaded one of his surgical friends, William Scott, to give ether for an operation the next day, the same day as Boott and Robinson in London and two days before Liston's operation.[11]

Doubts about this claim have been expressed because it seemed unlikely that Fraser could have got from Liverpool to Dumfries in the time, the railway in 1846 reaching only as far as Lancaster. However, the stretch from Lancaster to Carlisle was opened the day before the *Acadia* docked, so Fraser could have taken the new train to Carlisle, though he would still have had 33 miles to go to Dumfries. Another possible route was by sea, because a steamship, the *Royal Victoria*, sailed from Liverpool at 8pm the day after the *Acadia* docked, arriving 10 hours later at the port of Annan, where coaches waited to carry passengers the 16 miles to Dumfries. Either way, Fraser would have been home by the 18th, just time enough to tell William Scott the news and to get some ether prepared for an operation the next day in the Dumfries and Galloway Royal Infirmary.

Further doubt has been expressed recently, on the grounds that there is no trace of the patient.[12] It is true that today the hospital records no longer exist, but they still existed in 1847, the year that Simpson, Professor of Midwifery in Edinburgh, wrote to some fifty hospitals asking for their experience in using ether for amputations. The reply from Dumfries, which is preserved in the Royal College of Surgeons of Edinburgh, came from the house surgeon, Mr Borthwick, who said certainly an amputation was done by Mr Scott on a young man following a severe compound fracture of the thigh after a railway accident. He wrote:

> 'He had received ether but sank within two hours of the operation. No-one supposed the ether had the slightest influence in producing the fatal termination which everyone believed was caused by the twofold shock of the accident and the operation.'[11]

William Scott did eventually write to the *Lancet* in 1872 claiming his priority in the use of ether.[13] This is an interesting parallel with the claim of Crawford Long in America, who

waited two years before claiming to have used ether before Morton. In both cases the evidence is retrospective and circumstantial. However, it must be said that by their failure to publicise, neither Long nor Scott had any influence at all on the introduction of clinical anaesthesia.

The news spreads throughout the country

Sixty-four days after Morton demonstrated ether in Boston it was used, certainly in London, and probably in Dumfries, and the news spread quickly. During the weeks after 19 December there were, besides the *Lancet* at least half a dozen other general medical journals in circulation all carrying numerous reports of the discovery of ether. These journals were quickly distributed, and widely read not only by doctors, but also by lay journalists who quoted from them in their local newspapers throughout the country. By contrast, almost nothing is to be found in hospital records.

By looking at a few places whose first anaesthetic has been documented we can see how the news was acted upon. It must be remembered that at this time operations were quite rare and usually done as a last resort. For example, the Liverpool Royal Infirmary recorded only 80 in two years, whilst the Glasgow Royal Infirmary was busier having done 207.[14] This is not, of course, the total, for an unknown number were done in patients' homes or doctors' surgeries. Wealthier people would never have entered the hospitals where disease and infection were rife. Nevertheless, operations did not constitute a large part of a surgeon's practice.

Cambridge

Cambridge, less than 50 miles from London, was in 1846 a town of about 25,000 inhabitants with a large university. Addenbrooke's Hospital had been in existence for some 80 years and had about 100 beds. It was staffed by three physicians, three surgeons and a resident apothecary and his apprentice.

The *Cambridge Chronicle* on 9 January 1847 contained an entry headed 'Surgical operations without pain'. It read:

> 'A patient in the hospital underwent the operation of amputation of the finger on Saturday last (2 January) having been put under the aetherial influence, he underwent the operation without evincing the slightest pain.'

The surgeon was George Humphry, later Professor of Anatomy and of Surgery in the university. The apparatus used was devised by Mr William Swan Daniel, the apothecary's apprentice, though it is not recorded whether he or his master gave the ether. Three months later the *Chronicle* devoted an editorial to operations under ether, recording that by then over fifty had been done at Addenbrooke's, with no ill consequences. This happy situation did not last, since the same day a man who had been run over by a train died following an amputation under ether, although the inquest exonerated ether as a factor in his death. The minute books of the hospital make no mention of anaesthetics until the 1850s.[15]

Wisbech

Twenty miles north of Cambridge in the midst of the Fens is Wisbech, a small market town and river port, probably more flourishing in the 1840s than today, though it had no hospital. On 7 January, five days after Humphry's operation in Cambridge, a local surgeon, Mr Smith Burman, carried out dental extractions on three patients. The *Cambridge Chronicle* recounted that he had:

> '.... in the presence of several gentlemen - tested the American experiment of administering the vapour of ether as a means of deadening the sensibility of the nerves, with the most perfect success.'[15]

We do not know whether Mr Burman had heard about ether being given five days before in Cambridge, or whether he had read about it in the medical journals. Wisbech may seem remote in the Fens, but in the 1840s it had a medical man, Dr Tubbs, who travelled regularly to London to study mesmerism. Before Mr Burman experimented with ether he had removed a breast painlessly from a patient under mesmerism induced by Dr Tubbs.[16] Clearly, Wisbech was in the forefront of medical progress.

Lancaster

Lancaster was on one of the routes which the *Acadia's* doctor might have taken to Dumfries, but it seems no information dropped off here on 17 or 18 December. The first mention of ether in a local publication was in the *Lancaster Gazette* on 2 January 1847. It is a description of Liston's operation on 21 December. During the next few weeks there were numerous references to the use of ether in both the *Gazette* and the *Lancaster Guardian* but it was apparently not used in Lancaster until five weeks later. The *Guardian* reports then that a Robert Newby had his leg amputated under ether given by Dr Arnott, a physician. It stated that Newby was:

> '... rendered insensible to pain but not unconscious of what was going on around him .... when asked if he felt anything he instantly replied: "No, but I heard them sawing the bone"[17]

Glasgow

For a major centre with a long established university and medical school, Glasgow was slow to respond to the news. As in Lancaster, Liston's operation was reported, on 1 January in the *Glasgow Herald*. On 5 January the *Chronicle* reprinted much of the letter from Bigelow to Boott, but it was not until two weeks later, probably 27 January, that Professor Lawrie carried out the first operation under ether in the Royal Infirmary.

However, as in other places, the dentists got in first. John Henry Hill Lewellin had given ether for a dental extraction three weeks before on 4 January. Lewellin's source of information could have been either the *Herald* or the *Lancet* of 1 January, for at that time it was usual for mail to travel from London to Glasgow in one day. Dentist Lewellin was clearly an enterprising person for shortly after being the first to use ether in Glasgow he emigrated to Australia, where next we hear of him using chloroform to control the spasms of

tetanus in a young boy, very successfully because the patient made a full recovery after twelve days of intermittent anaesthesia.[18]

Sheffield

Sheffield, situated in the industrial Midlands was, in 1846, not an academic centre, though it had two hospitals. Rather it was a rapidly developing industrial city devoted to building factories, increasing trade and making money. Yet it was ahead of Glasgow. The first Sheffield patient to be anaesthetised was not in either hospital but is believed to be a Mrs Beckitt who had a finger amputated in her home. She had previously had an operation on her hand without anaesthesia and declared that this time she had far less pain.[19]

World-wide

The story would be incomplete without referring to the spread of anaesthesia world-wide. A list of 'firsts' in different countries (Figure 1) shows that, even in the days before radio and telephone, communications were fast and news spread quickly.[20] One would have expected that Paris and Vienna would be early, but it is surprising to see how soon doctors in Cuba, Latvia and Calcutta acted on the news. Obviously they communicated freely, read their journals and their newspapers avidly and acted upon new ideas promptly.

AMERICA		EUROPE		WORLD-WIDE	
		1846			
Boston	16 Oct	London)	19 Dec		
Philadelphia	29 Dec	Dumfries)			
		Paris	22 Dec		
		1847			
Canada	18 Jan	Glasgow	4 Jan	Calcutta	20 Mar
Cuba	10 Mar	Latvia	25 Jan	Cape Town	17 Apr
		Vienna	27 Jan	Penang	28 Apr
		Moscow	7 Feb	Sydney	3 Jun

Figure 1. First use of ether

The first twenty years

There is good evidence that the number of operations performed went up considerably after ether was introduced, yet there is equally good evidence that it was not universally used even as long as twenty years later. One must stress what a tremendous achievement it was for the early anaesthetists to have done it at all. Not many anaesthetists in the Western World have personal experience of using ether as a sole anaesthetic agent. It is irritating to breathe and its low potency makes for a prolonged excitement stage which is sometimes violent, often with profuse salivation, coughing and vomiting. To give a good ether anaesthetic requires considerable skill and the first anaesthetists, tentatively trying out a completely unfamiliar

practice, have not been given full credit for this aspect of their achievement. No wonder they were not always successful and surgeons became impatient and sceptical.

Many, perhaps most, of the early anaesthetics resulted in analgesia without unconsciousness and the surgeon operated speedily whilst the patient was coming round. With ether this level of 'painless awareness' is quite easily achieved and certainly safer than full anaesthesia at a time when airway control was little understood.

Simpson and chloroform

About a year after ether was first used the situation changed with the introduction of chloroform. James Simpson, Professor of Midwifery in Edinburgh, had visited Liston in London and heard about ether. He used it frequently after this from 19 January 1847, but in November of that year he wrote:

> 'From the time when I first saw ether-inhalation successfully practised in January last I have had the conviction impressed upon my mind that we would ultimately find that other therapeutic agents were capable of being introduced with equal rapidity and success into the system ..... I have had .... ethereal tinctures etc., of several potent drugs, manufactured for me for experiment ..... I have found one infinitely more efficaceous than any of the others, viz. chloroform, and I am enabled to speak most confidently of its superior anaesthetic properties, having now tried it on upwards of thirty individuals.'

Although Simpson receives, quite rightly, the credit for introducing chloroform into practice, he was not the one who discovered it or who first used it for anaesthesia. The first to suggest that it had properties likely to make it suitable as an anaesthetic was the chemist David Waldie of the Apothecaries Company of Liverpool, though Simpson never acknowledged Waldie's role. The first use of chloroform as an anaesthetic was recorded by Jacob Bell in February 1847, ten months before Simpson, whilst in the summer of the same year it was used by Holmes Coote with the surgeon Sir William Lawrence at St Bartholomew's Hospital.[21]

Without the drive, determination and, indeed, pugnacity of Simpson chloroform might well not have been taken up. Thanks to him it was accepted readily and for a while supplanted ether, probably because it was so much easier to give, being more potent and more comfortable to breathe. Chloroform's grave disadvantage soon showed up, the first sudden unexpected death in a fit patient occurring less than three months after its introduction.

Chloroform's Scottish protagonists claimed, against all the evidence, that if given in the way they did in Edinburgh it was completely safe and only the English had deaths, thus giving rise to what Sykes described as 'the Scottish chloroform legend'. Indeed, it was true that by 1855 there had been thirteen deaths in London and only one in Edinburgh, but then the population of London was 13.74 times the population of Edinburgh. As Sykes dryly put it:

> 'It would be difficult to get more equality in the death rate except by killing fractions of a person.'[22]

Arguments for and against chloroform continued far beyond the first twenty years of anaesthesia.

The waning of enthusiasm

Nowhere was anaesthesia universally adopted, surprising though we may find this today. After the initial novelty wore off, enthusiasm waned. I have referred to the delay of nearly half a century between Humphry Davy's prediction and Morton's demonstration, a delay for which there were many reasons. These included religious and cultural attitudes to pain and suffering, as well as beliefs on the part of surgeons that pain in some way aided healing and was a stimulus to survival.[23]

Although in 1846 painless surgery had at last become a practical possibility, these ideas did not disappear overnight. Surgeons became more sparing in their use of anaesthesia, reserving it for patients they felt had not the fortitude to take operations whilst awake. With unskilled anaesthetists and inefficient apparatus, anaesthesia was slow and did not always work. Even Liston, after his initial success, virtually gave it up, but then he was a notoriously impatient surgeon who prided himself on his speed and skill, thirty to forty seconds for a major amputation being usual for him.

That it was a risky procedure cannot be the whole reason. Fatalities from anaesthesia itself were infrequent, while deaths following surgery were common and remained inevitable until Joseph Lister introduced antisepsis twenty years later. The full benefit of anaesthesia could not be gained until surgical infection had been controlled.

However, it seems that anaesthesia progressed further and faster in Britain than elsewhere. America had introduced anaesthesia, but unaccountably failed to develop it further, as the Boston surgeon Collins Warren noted regretfully thirty years later.[24] Perhaps this was because of the acrimonious disputes about whose idea it was in the first place. Morton's initial secrecy and his attempts to profit by patenting the process did not help and may have brought anaesthesia into some disrepute. Pernick[25] has pointed out that in America rivalry between medical centres played a part. Anything emanating from Boston was regarded with the greatest suspicion in Philadelphia. Twenty years later Boston was using anaesthesia for virtually all its amputations, whereas Philadelphia's first amputation under ether was not done until 1853, whilst even until the 1880s less than 70% were given the benefit of anaesthesia. The practice in New York fell between these two patterns. Furthermore, the Philadelphia-based *American Journal of Medical Science* conspicuously failed to publish a single article on anaesthesia throughout 1847, a year when the *Lancet* published over 200 and the New England journals over one hundred. Philadelphia accepted anaesthesia only when it heard that Edinburgh and London had done so.

If America was not pushing things forward, neither was the continent of Europe, where surgeons continued to dominate the practice of anaesthesia. Important contributions were made, particularly by the French physiologists, but the eventual tendency in Europe was to develop spinal and local techniques in preference to general anaesthesia. British anaesthetists, by contrast, continued to improve the practice of inhalational methods.

Early specialisation

The reasons for this may perhaps be found in the early rise of specialisation which seems to have been unique to Britain. That Robinson published a textbook only a few weeks after he first used ether has already been mentioned, but a much more important book appeared six months later from the pen of the physician John Snow. Whereas Robinson was pragmatic and empirical, Snow was scientific and scholarly.

Dr John Snow

John Snow was a brilliant man who made significant contributions to several fields of medicine. Already he had a reputation as an outstanding physician and later he was to contribute to epidemiology by deducing that cholera was transmitted through infected water. When he read of Robinson's use of ether he lost no time in visiting him to observe the new procedure. At once Snow saw the potentiality and saw that, with proper scientific foundation, the administration of anaesthesia could become a predictable, effective and safe process. He went away, thought about it and practised it and within six months he published his first book: *On the Inhalation of the Vapour of Ether in Surgical Operations.*[26] In this textbook he set forth the general principles of inhalation anaesthesia with such insight that many still hold good today.

Snow went on to devote most of his practice to anaesthesia, the first specialist anaesthetist in the world, becoming in great demand by surgeon and patient alike and publishing several other scholarly books. Even Robert Liston had the grace to admit that when Snow anaesthetised for him it restored his faith in the procedure.[27]

Snow was invited to give chloroform to Queen Victoria for the birth of her eighth child, Prince Leopold.[28] Some of the Queen's physicians were dubious, but later she described it as: 'that blessed chloroform' and demanded it again for her next delivery. On this occasion Snow arrived late and found Prince Albert had already started to administer chloroform on a handkerchief. [29] The Queen's enthusiasm probably helped to encourage the use of anaesthesia at a time when it needed this encouragement.

Snow died sadly young aged 45. He is rightly regarded as the man who contributed most to the future success of anaesthesia in Britain. Fortunately, there was someone at hand to take over his mantle.

Dr Joseph Thomas Clover

Clover qualified, appropriately, from UCH, although it is unlikely that he saw Liston's first anaesthetic as he was on a medical firm at the time. He started as a surgeon, taking the FRCS but then become interested in anaesthesia. Whilst not of the academic calibre of Snow he was a skilled practitioner and an ingenious inventor. He designed apparatus for the quantitative administration of vapours and he introduced the use of nitrous oxide to smooth induction of anaesthesia before giving ether. He became London's leading anaesthetist and was a regular contributor at medical meetings, though his publications were limited to short papers.[30]

Conclusions

Britain was fortunate in several ways. Simpson not only introduced an anaesthetic agent much easier to give than ether, but also had the determination to publicise widely the desirability of using anaesthesia for all operations and in midwifery.

Even more importantly, there emerged right at the beginning such a brilliant man as Snow, the first in the world to professionalise anaesthesia and to inspire others to follow in his footsteps. The successful example of Snow and Clover paved the way for men such as Hewitt, Norton, Dudley Buxton and Silk to follow the path of specialisation. Perhaps it was the professionalism of men such as these that took British anaesthesia forward as a physician-based specialty at a time when, in America, it was becoming largely a nurse-based practice. It is tempting to think so.

There is still much to explain. Surprisingly, today, 150 years after its introduction, anaesthesia has not yet received the attention it deserves from academic historians. With the exception of Dr Barbara Duncum,[21] it has been left mainly to us, the amateur doctor-historians, to study its history and its impact and to make what we can of it. Maybe by the time we celebrate anaesthesia's bicentenary a historian of medicine will have emerged to do justice to the history, the traditions and the contributions to the whole field of medicine of the specialty in which we take such pride.

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THE PAINLESS SCALPEL

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Twenty five years ago I made my first professional visit to the United States. My first port of call was the Massachusetts General Hospital, where I was made to work hard with morning rounds starting at 7.00am, two lectures a day and long operating sessions. It was altogether a memorable, if exhausting, experience. Of many exciting moments, perhaps the one I remember now with the greatest of clarity, such was the impact upon me, was a visit to the Ether Dome, where I sat in the seat labelled with the name of Oliver Wendell Holmes, the anatomist, author and poet who coined the name *anaesthesia.* This occasion created a feeling of medical history such as I had never felt before.

I looked around and pictured the scene as it was in 1846, when the first operation was carried out under ether anaesthesia by John Collins Warren. This event has been depicted with artistic licence by several artists since, but was sadly not recorded at the time by the newly invented art of photography. A few days later a daguerrotype *was* made, posed for the two minutes or so as was then necessary, and resulting in the well-known image of the occasion. On the wall of the Ether Dome is an inscription detailing the events of that historic day and concluding 'a new era for surgery began'.

Surgery without anaesthesia

To put into perspective this new era let me remind you as to what surgery was like before inhalational anaesthesia. Benjamin Cotting, one of the spectators at that historic first ether operation, many years later wrote an article titled: *A bit of professional reminiscence, etherwise and otherwise.*[1] Here he describes a mastectomy:

> 'No mortal man can ever describe the agony of the whole thing from beginning to end, culminating in the operation itself with its terrifying expressions of infernal suffering. Our patient writhed beyond the restraining power of strong and experienced men, and groaned, to the horror of the terrified household; and afterwards, to the day of her death, could not think of the operation without convulsive shudders'.

Cotting then recalled another occasion:

> 'Soon after the ether discovery I performed a similar operation for a patient who declined to take ether; she knew she could bear it without flinching and did not wish to have her mind clouded or her senses benumbed. The first cut was borne pretty well; but the second was too much for her. She raved and stormed, roared out heavy groans and heart-rending shrieks. The operation would have had to be abandoned had not sufficient muscular force been provided for, quietly, in advance. She was held during tetanic-like spasms, and the operation was completed while she was in a position, almost that of opisthotonus. Her outcries aroused the neighbors, who rushed in in numbers to know what the occasion might be. In due time she recovered. But she never ceased to regret her mistake.'

Many other contemporary accounts exist of the horrors of surgical operations. It is indeed a wonder that any survived - they did; it is surely a tribute to the fortitude of the human spirit.

Introduction of anaesthesia - the popular view

The effect on the patient of the introduction of ether, and soon afterwards chloroform, is self-evident: the painless scalpel. What, however, was the effect on surgeons, and on the practice of surgery?

Fielding Garrison in his standard introductory text on the history of medicine[2], has this to say:

> 'The effect of these discoveries upon surgery was remarkable in many ways. First of all the surgeon, who in pre-anaesthetic days had to rush through an operation at lightning speed and under great disadvantages occasioned by the struggles and distress of the patient, could now take his time and therefore perform many operations impossible under the old conditions. The days of sleight of hand feats were over and the prestidigitations of a Cheselden, a Langenbeck, a Fergusson or a Pirogoff gave place to careful, deliberate procedure.'

So, according to Garrison, the introduction of anaesthesia caused surgeons to slow their operating technique and resulted in many new operations being introduced. Let me quote another opinion, from the journal *Science* in 1976:

> 'When general anaesthesia was first put to use in 1846, the practice of surgery exploded in many directions.'[3]

Similar views have been expressed in popular histories of medicine, and are widely believed by the lay public. But let me remind you we are now in the era of evidence based medicine, and that evidence based history became the norm some time ago - witness the ever increasing numbers of revised and updated and frank biographies of well known figures from the past. What therefore is the *evidence* for the wonderful effects of inhalation anaesthesia that these writers describe - the boon to the patient, to the surgeon and to the practice of surgery?
I shall consider the first two briefly, and the third in some detail.

Boon to the patient?

The *Lancet* for the decade 1847 to 1857 is a mine of information on the early years of anaesthesia in this country. Issue after issue in 1847 report successful operations performed under ether and, from 1848, under chloroform, with remarkable benefit to the patient. Three months into 1847 a physician (sadly anonymous) at one of the London hospitals wrote:

> 'There should be public acts of thanksgiving throughout the land for this signal favour to man present and to come ..... let physicians and surgeons be the first to bow the knee.'[4]

Three weeks later the first fatality was recorded. In later issues, many more deaths were reported - or rather not reported - leading eventually to a thunderous editorial in January 1851 condemning the fact that only successful cases were being recorded while 'the instances in which the patient has succumbed are buried in oblivion'.[5] By 1854, another editorial commented in regard to chloroform deaths that 'these events have become so common that they scarcely attract attention'.[6] As a consequence, some surgeons cautioned against the widespread use of anaesthesia, or even its use at all, contending either that pain was an essential part of surgical operations or that ether and chloroform were intrinsically noxious.

Thus, while anaesthesia in the early years was a boon to the patient in relieving pain, it also resulted in the death of many patients, deaths which would not otherwise have occurred. Case selection was paramount and surgeons of the time were sometimes slow to realise this. Anaesthesia was therefore not always a blessing for the patient; there are many accounts of patients refusing the offer, and submitting of their own volition to the painful scalpel.

Effects on the surgeon

> 'If I have any reputation in this way [ie surgery], I have earned it dearly for no-one ever endured more anxiety and sickness before an operation....'
>
> So wrote William Cheselden,[7] arguably the greatest English surgeon of the 18th century. His words must surely have been echoed by countless surgeons who found the ordeal of carrying out an operation on a screaming struggling patient upsetting in the extreme. The introduction of anaesthesia unquestionably had a major effect on the surgeons, not only in that they no longer needed to operate at great speed as noted by the historians of medicine, but also on their emotions and their psyche - they could operate and not inflict pain.

This new found freedom led to abuses. Let me quote again from the *Lancet*, in a leading article of 1851 titled '*The Mania for Operations*'. Referring to chloroform, the *Lancet* says:

> 'Like all great blessings, however, it has its drawbacks and evils, amongst the more conspicuous of which may be mentioned the facility with which patients are now persuaded to submit to the knife and the encouragement which it holds out to 'promising young men' to carve their way into practice.'[8]

The leader goes on to state that far too many operations were being performed - many scarcely justified by the clinical condition - with an unacceptable number of deaths. It points out to 'some of the young gentlemen who would vainly aspire to walk in the footsteps of an Astley Cooper or a Liston' that they should remember that such famous names owed less of their fame to their successful cutting but to the exercise of surgical wisdom and surgical judgement: 'Such men as these did not operate for the sake of cutting'.

So while it is true that surgeons could abandon speed of operation as a prerequisite for surgical outcome (and largely did, as the administration of anaesthesia became safer), and while it is true that emotionally the performance of an operation was not the harrowing experience for the surgeon it once was, it is also a fact that many inappropriate operations were carried out as a result of the surgeons' new-found enjoyment of cutting!

Effect on the practice of surgery

Did ether and chloroform in the first twenty years have a major effect on the practice of surgery? Surprisingly, evidence on the early impact of anaesthesia on surgical practice is sparsely documented in secondary literature, and I thought at one time that I should have to go back entirely to primary sources. Fortunately, I discovered that Professor Nicholas Greene of Yale had looked at this matter in considerable detail, and the information I present owes a lot to his work.[9]

Let me first of all remind you that in the mid-nineteenth century substantial numbers of operations were performed outside hospitals - in people's own homes. Only anecdotal accounts exist of such operations performed in the home environment. In contrast, detailed statistical information regarding their surgical practice was published in hospital reports both in Britain and the United States. These reports were meticulously prepared by the surgical registrars of the day. A registrar was then truly a registrar! There is no evidence that the types of operation performed in the home were different from those in hospital, so the data I present are likely to be a fair reflection of the state of surgery at the time.

As anaesthesia originated in Boston, let us look first at pre-anaesthetic Boston statistics - from the Massachusetts General Hospital where it all began (Table 1).

Operations Performed at Massachusetts General Hospital, 1821-1846*

Amputations, extremities	123
Amputations, penis	4
Aneurysm	15
Ligation arteries	17
Urinary bladder operations	17
Cancer of	
breast	62
face	2
nose	1
head and neck	1
lower lip	22
penis	4
leg and thigh	3
tongue, mouth, and upper lip	9
Castration	33
Clubfoot	20
Total	333

* Excluding (1) puncture, incision or drainage of abscesses; (2) fissures and fistulae in ano; hemorrhoidectomy.

TABLE 1

Note that almost all the operations are superficial. There are no operations on body cavities, except the urinary bladder. Compare this with pre-anaesthetic operations at Guy's Hospital, London (Table 2), and in several hospitals in Scotland (Table 3). The lists of procedures are almost identical. If we now look at the MGH statistics in the early years after the introduction of ether (Table 4), we see no change in the range of operations performed. This is most unexpected, but statistics in the 1860s and 1870s from other US hospitals such as New Haven and Boston City Hospitals, also show no body cavity surgery, and specifically no abdominal operations. Table 5 shows that in the 1850s the operations at Guy's Hospital were also little changed.

Operations Performed at Guy's Hospital, London

	Jan. 1, 1843–Dec. 31, 1843	Jan. 1, 1844–Dec. 31, 1844	Jan. 1, 1845–Mar. 31, 1846	Apr. 1, 1846–Mar. 31, 1847
Amputations	24	23	34	30
Hernia	3	7	11	18
Lithotomy	7	13	18	4
Lithotrity	2	2	3	2
Ligation arteries	2	3	2	3
Trephine	4	3	1	—
Exc. tumors	24	24	41	12
Castration	—	1	1	1
Exc. bone or cartilage	—	2	3	4
Harelip	1	1	—	—
Exc. breast	—	—	—	9
Ovariotomy	1	—	—	—
Tracheotomy	—	—	2	—
Cleft palate	1	—	—	—
Miscellaneous	4	12	22	18
Total	73	91	138	101

TABLE 2

Operations Performed in Eight Civil Hospitals in Scotland in 1844

Amputations	154	Tracheotomy	5
Cleft palate	1	Fistula in ano	20
Cataract	17	Harelip	7
Exc. elbow joint	5	Hernia	11
Exc. malignant tumors:		Hydrocele paracentesis	20
upper jaw	2	Lithotomy	28
lip	15	Laryngotomy	1
cheek	2	Lig. arteries	5
neck	2	Perineal cystotomy	2
breast	17	Paracentesis ascitis	4
other	5	Exc. testicle	2
Exc. nonmalignant tumors	18	Strabismus	1
Exc. tonsils	2	Tenotomy	9
Exc. hemorrhoids	1	Trephine	3
Exc. "other parts"	33	Miscellaneous	16
		Total	408

TABLE 3

Operations Performed at Massachusetts General Hospital, 1847–1870*

Amputations, extremities	1098
Amputations, penis	12
Aneurysm	46
Ligation arteries	31
Urinary bladder operations	88
Cancer of	
breast	237†
face	5
nose	7
head and neck	4
lower lip	148
penis	7
leg and thigh	4
tongue, mouth, and upper lip	6
Castration	84
Clubfoot	147
Total	1924

* Excluding (1) puncture, incision, or drainage of abscesses; (2) fissures and fistulae in ano; hemorrhoidectomy.

† Including 233 excisions and 4 amputations.

TABLE 4

Operations Performed at Guy's Hospital, April 1, 1853–Sept. 30, 1853

Amputation	25
Hernia	9
Oper. on bones of head	3
Lithotomy	9
Lithotrity	2
Incision perineum	4
Exc. necrotic bone	15
Exc. elbow	2
Lig. arteries	2
Exc. tumors	40
Laryngotomy	1
Division sphincter	11
Miscellaneous	12
Total	135

TABLE 5

At Guy's, however, by the 1860s (Table 6), a small number of new operations began to appear, namely splenectomy, gastrotomy, colotomy and especially ovariotomy, the first abdominal procedure to gain widespread acceptance.

Operations Performed at Guy's Hospital, 1861-1868

Amputations of limbs	305	Oper. on blood ves-	
Exc. tumors:		sels	41
breast	147	Plastic operations	114
cancerous	75	Urethral operations	65
fibrous, fibroid and en-		Transrectal cystot-	
cysted	91	omy	30
cartilaginous	19	Litholomy, lithotrity	122
vascular and nevus	14	Trephine	51
fatty	50	Pharyngotomy	1
glandular	8	Laryngotomy	2
Exc. diseased joints	13	Tracheotomy	65
Exc. diseased bones	234	Abd. section for de-	
Exc. spleen	2	formed pelvis	2
Exc. "end of stump"	14	Cesarean section	1
Exc. penis	24	Gastrotomy	1
Exc. testicle	35	Colotomy	4
Exc. tongue	1	Ovariotomy	44
		Hernia	152
		Total	1667

TABLE 6

This information I find fascinating. It shows that contrary to popular belief there is virtually no evidence from hospital statistics that the type of surgery practised was influenced in any way by the introduction of ether and chloroform. Similar statistical tables were published by other hospitals and I can find no evidence that MGH and Guy's were any different to other hospitals in the States or in Europe. For example, the ascendancy of surgery in German-speaking Europe did not start until the mid-1880s.

However, one of the doyens of medical history in this country, Dr Frederick Cartwright, has pointed out that there *were* the beginnings of change in surgical practice.[10] For example, the 'radical' cure of hernia rather than simple herniotomy was starting to be performed in the late 1850s and, in France, Chassaignac introduced a new method of treating fractures by traction, which required the patient to be anaesthetised. In London, William Fergusson of King's College Hospital (often working with John Snow), was beginning to excise diseased joints rather than amputate the limb - a treatment he called 'conservative surgery'. These, and other innovations, were enabled by the abolition of the need for speed in operating. But their widespread adoption was relatively slow. They were practised by a few enthusiasts and were not representative of mainstream surgery of the time. An analogy today might be some

laparoscopic operations, such as laparoscopic colectomy or adrenalectomy, practised by enthusiasts because the technology is there, but whose real place in surgery is yet to be defined.

Why did anaesthesia seemingly have so little immediate effect on the development of surgery? It was of course a prerequisite for many of the advances that took place in the latter part of the 19th century. These could not have occurred without anaesthesia, but control of infection was also necessary, as well as a deeper understanding of physiology and pathology. In celebrating the 150th anniversary of anaesthesia, however, it would be sad to finish on a note that was less than high. Allow me then to quote from William Fergusson's lectures of 1867, just twenty years after the birth of anaesthesia and before the adoption of Listerism:

> 'I see nothing which has transpired in the present century, which in magnitude or importance, can compare in our annals with anaesthesia, and in my mind it ranks in value to mankind scarcely less than the results of the labours of Harvey and of Jenner.'[11]

Thus speaks a surgeon who was there!

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THE CURSE OF EVE
The Early History of Anaesthesia in Midwifery

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In the beginning

In the beginning, when God created the heavens and the earth, the earth was a formless waste-land, and darkness covered the abyss while a mighty wind swept over the waters. Then God said: 'let there be light', and there was light. And God saw how good the light was. Then God said: 'let us make man in our image, after our likeness'. The Lord God created man out of the clay of the ground and blew into his nostrils the breath of life, and so man became a living being, formed in the divine image of God who had created him. And the Lord God said: 'it is not good for the man to be left alone', and so the Lord God formed the various wild animals and the birds. None proved to be a suitable partner for the man.

So then the Lord God cast a deep sleep on the man, and while he was asleep, he took out one of his ribs and closed up its place with flesh. The Lord God then built up into a woman the rib that he had taken from the man. The couple ate from the forbidden fruit and were cast out of the garden of Eden. The man took the woman unto him and called his wife Eve and she became the mother of all the living. (Bible, Genesis 1.1-3.24)

The Curse of Eve

The Lord God cursed the man and to the woman he said: 'I will intensify the pangs of your child bearing; in pain shall you bring forth children'. (Genesis 3.16) This biblical passage became known as the 'Curse of Eve', although no sentence was passed on the woman and the scriptural passage contains no curse. From that time onwards, through succeeding generations, pain was deemed a necessary feature for successful childbirth. Indeed, in the Judeo-Christian belief, pain was seen as a means to salvation inflicted by a vengeful god as punishment for sin[1]. The long-held views on morality gradually became intertwined with medical dogmata and the use of analgesia was thought to be contrary not only to religious belief but also to medicine and the laws of nature.

And the Lord god blessed them: 'be fertile and multiply; fill the earth and subdue it' (Genesis 1.28). And what effect did that have on women? It condemned them not only to the pangs of parturition but also the lonely painful throes of death in childbirth.

Ancient analgesia

The apparent Biblical, and patriarchial, views on analgesia were not common to all societies. For instance - in ancient Assyria some 5000 years ago, the mandrake (*mandragora officinalis*) and henbane (*hyoscyamus niger*), both of which contain the effective analgesic hyoscine (*Scopolamine*), were used to relieve the pain of childbirth[2]. Indeed, it is related in the Bible that the mandrake was sought by Rachel for Leah, but it is generally held that the remedy was to be used as an aphrodisiac rather than an analgesic.

The poppy, from which opium is obtained, was also known to the ancient world and was included in many prescriptions. In the 16th century Paracelsus coined the term laudanum for tincture of opium. In the 18th century, Fielding Ould of Dublin was one of the first obstetricians of relatively modern times to advocate the use of tincture of opium for the labouring woman. However, the 'father of American obstetrics', one William Potts Dewees of Pennsylvania, wrote in 1819 that although opium was a favourite remedy of many accoucheurs he did not favour its use as, in common with contemporary thought, he found that opium weakened uterine contractions.[3]

Midwifery statistics 17th - 19th centuries

The 'Curse of Eve' can best be appreciated by quoting some statistics from the 17th through the 19th centuries. Mortality figures for mothers dying in childbed in London show that, in the year of 1660, one of every 44 mothers was lost. By 1780, the statistics had improved somewhat so that a figure of 1 in 82 was recorded. Sixty years later the proportion of maternal deaths in childbed for England and Wales had reached an all-time low of 1 in 192.[4] Imagine the pain and suffering related to those statistics and, of course, the many traumatic episodes not alluded to in those figures.

One of the major determinants of maternal mortality was the duration of labour. John Burns,[5] Professor of Surgery at Glasgow, wrote in 1820 that 12.5% of women who experienced: 'tedious labour' (i.e. in excess of 24 hours) would die and that the percentage rose alarmingly with each passing hour. Instrumental delivery by forceps boosted that figure to a shocking 40 - 50%, while half of the infants in the group also died.

The results from the Dublin Lying-In Hospital (later to become The Rotunda) for 1826-1833 only served to confirm the worst, showing that women who delivered soon after hospitalisation had a maternal mortality rate of 1 in 320 compared to 1 in 11 where labour was prolonged over 20 hours, with worsening statistics as labour continued.[6] Prolonged labour occurred in primigravidae or where disproportion and/or uterine inertia were present.

Difficult delivery

Disproportion was commonly due to pelvic deformity, which itself was secondary to childhood rickets, or to osteomalacia in adult life - both of which were penalties of the industrial revolution with its increasing urbanisation and malnutrition. The normal true conjugate diameter of the pelvic brim should be in excess of 4 inches. When labour was obstructed vaginal delivery was attempted if the true conjugate measured 2 inches or more. Forceps or vectis delivery, or version and breech extraction, or craniotomy and crotchet extraction were performed without analgesia in the exhausted woman. The attendant mortality from haemorrhage, sepsis and shock reached over 80%. If the true conjugate was less than 2 inches the woman was left to die. Caesarean section carried a maternal mortality of almost 100%. A contemporary account reads:

> 'The patient was lame and deformed .... the diameter of the brim was about 2.5 inches. After three days the long forceps was applied and two accoucheurs attempted in vain, for about two hours, to extract the head. They then broke down the skull with the perforator, and emptied the cranium; but still, in this greatly diminished state, the (mutilated) head

required nearly an hour's strong traction with the crotchet, before it could be made to pass the contracted brim.'

Ether anaesthesia

Meanwhile, in America, in the 1830s, the intoxicating effects of ether became well known and 'ether frolics' were popular. Although not the first to use ether, the Boston student, and later dentist, William T G Morton,[7,8] is commonly regarded as the discoverer of anaesthesia. He gave effective anaesthetics on 30 September and, more famously, on 16 October 1846. Word spread quickly across the Atlantic and, on 21 December, Robert Liston in London performed a leg amputation under ether anaesthesia.

Ether and midwifery

During a trip to London, James Young Simpson, Professor of Midwifery at Edinburgh, met with Robert Liston and so became aware of the use of ether in major surgery. He decided to extend its use to midwifery. At his home in 52 Queen Street, Simpson inhaled ether vapour in an attempt to evaluate its characteristics and potential anaesthetic effects. Then, on 19 January 1847 came the first recorded instance of the use of anaesthesia in a midwifery patient when Simpson employed ether in a case of obstructed labour.[9]

The woman's pelvis was greatly contracted. Her first confinement had ended in a craniotomy procedure. Despite medical advice to have induction of premature labour in her second confinement the woman did not appear until she was in labour at full term. The cervix remained half dilated and the head did not enter the pelvis over many hours. Assisted by doctors Keith and Zeigler and the woman's medical attendant, a Mr Figg, Simpson made the patient inhale the ether vapour. While the woman was under its anodyne influence Simpson turned the baby to the breech position and proceeded to a breech extraction manoeuvre. Extreme exertion was required to effect the delivery. The fetus gasped several times but respiration could not be established. The infant's right parietal bone was deeply indented and in its compressed state of just 2.5 inches the fetal head mirrored the size of the pelvic brim. The infant weighed eight pounds. The patient was unconscious of pain but felt the child 'jerk' from her and was filled with wonderment and gratitude at her painless delivery.

Spread of anaesthesia in obstetrics

News of Simpson's momentous achievement spread rapidly and, soon afterwards, the use of ether anaesthesia in midwifery was reported from France and Germany. In the USA, the first obstetrical anaesthetic was undertaken by Dr Nathan Cooley Keep, a Boston dentist, on 7 April 1847.[10] The patient had five inhalations. Consciousness was unimpaired; pain was relieved and the 30 minute labour was not retarded.

Dr Walter Channing, Professor of Obstetrics at Harvard, sensed the importance of Keep's application of ether to midwifery and went on to become the champion of anaesthetic midwifery in America. Channing's important contribution: *A Treatise on Etherization in Childbirth* was published in Boston in 1848.

Meanwhile, in Edinburgh in the autumn of 1847, with the help of his associates, Dr Thomas Keith and Dr J Matthews Duncan, Simpson began a search for an alternative agent. Ether he had found to be unpleasant to inhale; its onset of action was slow; a special inhaler was necessary and a large quantity was required. He wanted something more practical.

Chloroform

At the suggestion of David Waldie, a Scots chemist working in Liverpool, Simpson and his colleagues inhaled the vapour of chloroform on 4 November 1847. Simpson discovered that the substance was 'far stronger and better than ether'. Four days later, on 8 November 1847, Simpson used chloroform for the delivery of the wife of a Dr Carstairs of Edinburgh.[11] Their first child had been delivered by perforation of the head and fetal extraction after a labour of three days duration. In her second confinement, at 38 weeks of gestation, Simpson induced chloroform anaesthesia: 'by moistening, with half a teaspoonful of the liquid, a pocket handkerchief, rolled up into a funnel shape, and with the broad or open end of the funnel placed over her mouth and nostrils'. A living child was expelled within 25 minutes and was presented to her astonished mother. The grateful parents named their daughter 'Anaesthesia'. Simpson found the clinical effects of chloroform were much superior to ether but cautioned that such a powerful drug could produce serious consequences if used by 'unprofessional individuals'.

Controversy

The use of anaesthesia in midwifery unleashed a controversy without equal in medical history. Simpson was attacked by surgeons, obstetricians, clerics and the lay public. Never a man to be put down, Simpson marshalled his facts and figures and entered the fray in a spirited fashion. Attack is often-times the best method of defence. He collected statistics on surgical amputation of limbs, and showed that where anaesthesia was used the mortality was reduced by up to 50 percent. He quoted a letter written to him by an amputee which detailed that man's suffering: 'the black whirlwind of emotion, the horror of great darkness and the sense of desertion by God' as he helplessly 'gave himself up to the cruel knife'. The medical pundits pointed out that labour did not compare to surgical operations. They also claimed that anaesthesia would increase the operative mortality in obstetrics and would be responsible for insanity, haemorrhage and convulsions in the mother and would promote idiocy in the neonate if it were lucky enough to be born alive.[12]

William Featherstone Montgomery, Professor of Midwifery to the King and Queen's College of Physicians in Ireland, was drawn into the fray in 1849.[13] While acknowledging that the application of anaesthesia was 'a remarkable event' he incorrectly claimed that ether had not been used in Dublin. He was against its use in natural labour to 'avert the ordinary amount of pain which the almighty has seen fit - and most wisely we cannot doubt - to allot to natural labour'. Montgomery also objected to the use of chloroform: 'In all operations with the crotchet ..... lest under the full sedative effect .... we should inflict an (maternal) injury.' A woman should not be kept, wrote Montgomery: 'in a state of stupefaction .... with her blood blackened, and her brain poisoned'.

In the same year that Montgomery wrote his objections, Robert Shekelton of the Rotunda Hospital reported the use of chloroform in 56 cases and, in the following year, chloroform was used at the Rotunda for one in every 37 deliveries.[14]

In America, the eminent obstetrician Charles Meigs wrote to the *Philadelphia Medical Examiner* in March of 1848 that the pain of parturition was: 'a physiological pain', but in his textbooks *Females and their Diseases* and the *Philadelphia Practice of Midwifery* he said : 'there is no name for it but agony .... absolutely indescribable'.[15] Meigs wrote to Simpson at the height of the controversy: 'Should I exhibit the remedy .... to prevent the physiological pain, and for no other motive, and if I should in consequence destroy only one of them, I should feel disposed to clothe me in sack cloth, and cast ashes on my head, for the rest of my days'.[16] The Biblical allusion is striking.

Other obstetricians joined the debate. Samuel Ashwell of Guy's Hospital, London wrote in 1848 that: 'the unnecessary interference .... with healthy labour .... is sure to be followed by injurious and fatal consequences' and asserted that: 'meddlesome midwifery is still a bad midwifery'.[17] Merriman[18] was also opposed to the application of anaesthesia to midwifery and wrote in 1848 that: 'in savage nations .... child-birth appears easily accomplished; the mothers suffer little' and he extolled the: 'great superiority of allowing nature to conduct the whole process of the birth'.

Simpson recalled the words of Galen: 'dolor dolentibus inutilis est' (pain is useless to the pained) and claimed that: 'certainly our patients themselves will force the use of it upon the profession'.[19] Noticeably absent in the debate was the voice of women, presumably because there were no female accoucheurs, and also the midwives of the time were either poorly educated or did not publish their comments. However one woman wrote to the *Boston Medical and Surgical Journal* in 1866 that: 'one great reason for the aversion to child-bearing .... is the certain agony at the end .... if the blessed, benevolent suggestion of the use of chloroform could be adopted, the world would hear less of abortions'.[20]

The Curse - reinterpreted

So, let us return to the Judeo-Christian beliefs, where we have Biblical precedent and authority for the painless birth of Adam; the painless birth of Eve while Adam was asleep and the apparent reason for pain in the labouring woman - and the medical logic which reasoned that pain should not be relieved.

The Curse of Eve (Genesis 3.16) indicated that pain was a prerequisite in childbirth. One clerical opponent of anaesthesia claimed that: 'Chloroform is the decoy of Satan, apparently offering itself to bless women, but in the end it will poison society and rob God of the deep, earnest cries which arise in time of trouble for help'.[21] Simpson sought an interpretation of the original Hebrew from which the 17th century English version of the Bible was translated, and deduced that the word 'etsebh' which the English scholars interpreted as sorrow did not mean pain, rather it referred to muscular effort.[22] Not everyone agreed with his translation, but many colleagues wrote in support of his medical and moral views.

The topic of pain relief in labour still generated much moral discussion until recent times. In the 1960s, Grantly Dick-Read [23] and Jeffrey Boss[24] investigated the so-called 'Curse of Eve'

and deduced that the original Hebrew referred to 'toil' or 'toil and trouble' and when the original roots of the Hebrew words relating to childbirth were investigated it appeared almost incompatible with there being any reference to physical pain.

Early anaesthetic results

Simpson argued his case for the introduction of anaesthesia to midwifery with his publication of early results culled from his own practice and those collected from various practitioners who had espoused the cause.[25] The maternal mortality rates for women who had received anaesthesia were lower than the recorded average for England and Wales of the same era. Maternal mortality was of course a crude indicator of the benefits of effective analgesia in labour. Women and their obstetricians voted with their feet and their labours, and ether or chloroform became very popular. Soon, as foretold by Simpson and his adversaries, anaesthetic related deaths were recorded. On the other hand, many lives were saved, thus achieving statistical gains in the fight for reduction of mortality rates; and, of course, much pain and hardship in labour were avoided. The benefits of anaesthesia were later exploited by the introduction of a range of analgesic drugs for the labouring woman.

The parallel introduction of ergot to obstetrics focussed even more attention on 'tedious' and prolonged labour. Developments in the surgical techniques and conduct of caesarean section would follow later in the 19th century and so the stage was set for the move towards modern obstetrics.

The seal of perfect propriety

The seal of perfect propriety on the use of anaesthesia in midwifery was set by the hand of John Snow. At the request of Sir James Clark, physician, and Charles Locock, obstetrician to the Queen, Snow administered chloroform to Queen Victoria for the birth of Prince Leopold in 1853. The technique of 'Chloroform à la Reine' became fashionable and the 'Curse of Eve' could at last be addressed.

Chloroform was inhaled by the Queen, during contractions, for a total of 53 minutes, without removing consciousness. The Queen was later quoted as saying: 'Dr Snow gave the blessed chloroform and the effect was soothing, quieting and delightful beyond measure'.[26]

Epilogue

And so, James Young Simpson, born at Bathgate on 7 June 1811, entered the history books as the innovator who introduced anaesthesia to midwifery in 1847, one of the greatest contributions to the noble art of obstetrics. A recipient of many honours, including a knighthood, he achieved world stature in his own lifetime. Sir James Young Simpson died in 1870 at the age of 59. His wife declined the national honour for him of burial in Westminster Abbey, but a bust was erected there to his memory with the inscription:

'To whose Genius and Benelovence
The world owes the blessings derived
From the use of Chloroform for
The relief of suffering. Laus deo'

Asleep in the arms of Morpheus! An alternative epitaph was penned by a local Scottish wit and reads: 'Does your mither know you're oot?'.

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SCOLDING WIVES, SQUEALING PIGS AND OTHER MATTERS

The lay reaction to the introduction of anaesthesia in Victorian England

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Following the first successful public demonstration of ether anaesthesia, news travelled rapidly to the United Kingdom. The first use outside the United States was by James Robinson in Gower Street, London on 19 December 1846. Two days later, Robert Liston amputated the leg of Frederick Churchill under ether anaesthesia at University College Hospital. These early anaesthetics were reported widely in the national and provincial newspapers of the time. But Victorian society was very different from that of today. In studying the written reports and reactions to these early anaesthetics, the degree of literacy and the nature of caring within the society must be addressed.

Victorian Literacy and Education

The source material for studying Victorian England is mostly the written word. Social classes 1 and 2, to which professional groups belong, must have approached 100% literacy, so the medical texts of the time are representative of medical opinion. However, in social classes 3, 4, and 5 literacy could fall as low as 20%. The views of these groups are therefore difficult to chronicle, unless reported second hand.

In his study of marriage certificates of the period, Vincent[1] quantified literacy by the test of ability to sign a name on the marriage register. Following Hardwick's Marriage Act of 1754, weddings only became valid when they were entered in the parish register and signed by the bride, bridegroom and two witnesses. These records were kept locally until the Registration of Births, Deaths and Marriages Act of 1836 made the system the responsibility of the Registrar General who, in his annual reports, would publish tables of literacy. As the occupation of the bridegroom and of the bride's father appear on the certificate, the figures may be broken down by social class. Table 1 illustrates the large gap in literacy between social class 1 and the miner's subdivision of social class 3.

Whilst it is not in the scope of this paper to give a history of the developments in education, the landmarks on the road to full literacy occur in the exciting period of Victorian England that includes the discovery and development of inhalational anaesthesia. These milestones include the efforts of the National and the British and Foreign School Societies in 1833. The Revised Code of 1862 placed the teaching of basic literacy at the core of the curriculum. This change in defined standards brought forth a new generation of textbooks, for example, J S Laurie's Graduated Series of Reading Lesson Books which appeared in 1866. The State did not become involved until Foster's Education Act of 1870 when elementary education became compulsory. Lord Sandon's Act of 1876 brought the Church and the State together in the ambition of driving out the unqualified independent school teacher. This was followed by Mundella's Act of 1880, which closed perceived loopholes in compulsory education by the passing of bylaws, though children between the ages of ten and thirteen could still terminate their education once they had reached Standard IV.

Occupational literacy of grooms[2]

Social class	1	2	3						4	5
			H	**L**	**T**	**P**	**Met**	**M**		
1844/9	96	91	83	89	58	50	60	20	66	41
1914	100	100	98	100	100	100	100	99	99	99

H - Traditional handicraft trades
L - Trades in which some degree of literacy was a condition of entry
T - Textile workers
P - Potters
Met - Metal workers
M - Miners

Table 1

Caring and Cruelty in Society in 1846

Quite apart from expecting an education, a child, one hundred and fifty years ago, would work. This is dramatically illustrated by the case of Albinus Burfitt, aged 11, who was one of the first five patients in Britain to die in association with an anaesthetic. His death certificate[3] gives his occupation as labourer and describes the cause of death in a mill accident:

'By clasping with his hands a Shaft in a Mill propelled by water and having a Linen apron on his person the same was drawn around the Shaft by means whereof he received divers bruizes and fractures upon his legs and thighs.'

The Factory Act of 1833 had imposed tougher laws to prevent the exploitation of children. However, within the terms of the Act, a child aged from thirteen to eighteen could still work 12 hours a day, whilst a child aged between nine and thirteen was limited to 9 hours. There was a ban on children under nine years of age working and on anyone under eighteen years working nights.

In America, the situation was similar. Slavery would not be abolished until the Emancipation Proclamation signed by President Lincoln in 1863. Slaves suffered not only at the hands of their masters but also from medical men in the Southern States where there was unquestioned belief in the slave's lack of sensibility. Examples include that of a Virginian physician who experimented with a cure for pneumonia by pouring boiling water over the bare back of his subject. A Georgia doctor trying the same experiment expressed genuine surprise when the patient leapt up and appeared to be in agony. Even the opponents of slavery, such as Dr Rush, an early American abolitionist, held the belief that slaves did not feel as much pain as their masters.[4]

So, in a world where slavery, cruelty, child labour and illiteracy were commonplace, William Morton gave the first successful public demonstration of ether anaesthesia at the Massachusetts General Hospital on 16 October 1846. This event has been described by many authors including Nathan Rice[5] in 1859, *Trials of a Public Benefactor* being commissioned by Morton himself. Vandam believes that Morton never received a medical degree and that his dentistry qualification was honorary and presented after the demonstration of ether anaesthesia.[6] Thus, in the context of the lay reaction to anaesthesia, the first public use belongs to a layman. The late Richard Ellis has described the several means by which the news spread to the United Kingdom.[7]

Early Press Reports

The early anaesthetics in London and around Britain were well reported in the national and provincial press. Most of these reports were of a factual nature offering little opinion on the subject of ether anaesthesia; when an opinion was proffered it was usually in support of the new discovery. A typical example of this is to be found in the *Illustrated London News* of 9 January 1847[8] in an article entitled *The new means for rendering surgical operations painless:*

> 'LAST WEEK, the first experiment was made in this country of employing the inhalation of the vapour of sulphuric ether as a means of rendering surgical operations painless. The application is of American origin, and was first introduced, a few months since, by Dr Morton, a dentist, of Boston, U.S., by whom it was communicated to Dr Boott, of Gower Street. By this gentleman this discovery was described, on the 17th of last month, to Mr Robinson, the surgeon-dentist, also of Gower Street; who on the following day, operated on a young lady thrown into sleep by the inhalation, during which a molar tooth was extracted from her lower jaw. The inhalation occupied a minute and a half, and the patient's recovery from sleep another minute. Dr Boott questioned her respecting the tooth, and she expressed her great surprise at finding that it was removed. She said that all she had felt was merely a sensation of cold around the tooth, a sensation which was caused, perhaps, by the coldness of the extracting instrument.'

'The apparatus employed consists of the lower part of Nooth's apparatus, with a flexible tube, to which are attached a ball and socket valve and a mouthpiece, similar to those commonly used for inhalation. The apparatus has been constructed by Mr Hooper of 7 Pall Mall, East according to Dr Boott and Mr Robinson's instructions: it is very elegant in appearance.'

'The apparatus has since been successfully used in operations at King's College Hospital, by Mr Fergusson; and on Thursday last, by Mr Aston Key, at Guy's Hospital; among other cases was the removal of an abscess from the great toe of a female: in this case the means was not entirely successful, for the patient screamed at the moment of the first incision of the instrument, but, on recovery, from the effects of the inhalation, was totally unconscious of the operation having been performed.'

The article also contains a diagram of Nooth's apparatus, and a description of its parts and mode of working that would not have been out of place in a medical journal.

The first positive opinion in the *Times*[9] came in a short piece on 1 January 1847, though this was actually referring to an article in *The Zoist*[10] on the conversion of the Medical Profession to the Duty of Preventing the pain of surgical operations. The Zoist described itself as 'A Journal of Cerebral Physiology and Mesmerism and Their Applications to Human Welfare'. In Volume IV, prior to January 1847, many case reports of apparently successful mesmerism for quite major surgery are to be found with titles like: *Removal of a tumour frightfully* disfiguring the face.

An example of how the mesmerists coped before anaesthesia can be found in Dr Elliotson's description of an occasion in June 1846 when he laboured for three quarters of an hour to produce insensibility by mesmerism in a forty year old peasant, and then how a tumour of the antrum maxillare was removed without pain:

'The pressure of the tumour had caused the absorption of the anterior wall of the antrum, and on pushing my fingers between it and the bones, it burst, and proved to be a medullary tumour. A shocking gush of blood and brain-like matter followed.'

Following surgery:

'The man declares by the most emphatic pantomime, that he felt no pain while in the chair, and that he first awoke on the floor.'

With this background, it is not surprising that this journal should be so positively in favour of ether anaesthesia. The article to which the *Times* alludes was actually entitled: *Conversion of the medical profession to the solemn duty of preventing the agony of surgical operations*. The first part is a transcript of a letter written in America to a Miss Edgeworth:

'With us here in Boston is a new adaptation of gas from ether which removes all sensibility to pain from the most fearful surgical operations. It is a blessing to the human race unequalled since the first application of vaccination. I speak decidedly, for it has within the last month been so repeatedly tested without failure in our admirable hospital by skilful surgeons, that it is an accredited fact. It is gas from ether, inhaled through the mouth,

> which produces a tranquil dreamy state, an entire inaction of the muscular system, a total insensibility to pain, but a slight perception of sound, which enters into this sort of dream that is passing through the mind.'

The article continues with a description of the author's child having a tonsillectomy without pain under ether anaesthesia, the gas apparently being administered by Charles Jackson. In discussing the letter, Elliotson states:

> 'If this plan [etherisation] produces insensibility to pain in more instances than mesmerism, and quite as innocently and easily as when mesmerism succeeds, it will be a blessing, and none will hail it more joyously than we mesmerists, who have no other object than the good of mankind.'

Alluding to earlier opposition within the medical profession this simile appears:

'Yet, though this mighty mass of prevention of agony has been as disregarded by the profession as the treasures of the British Museum are by the horses of the cab-stands in all the surrounding street.'

The writer in *The Zoist* is clearly well-read as he continues to discuss Liston's part in the story, quoting from the *Lancet*, *London Medical Gazette*, and *Medical Times*. The letter from Dr Boott in the *Morning Chronicle* announcing the American fact is also quoted. Compared with the mainstream medical journals of the time, *The Zoist* is very well cross-referenced with many footnotes and annotations.

Items concerning the unfolding story of anaesthesia continued to appear in the *Times* in January 1847. By the 4th, the use of ether at the Bristol General Hospital for the amputation of the leg of a young man is reported in favourable terms[11]. Under this article is a letter from William Herepath, an analytical chemist who was present at the Bristol demonstration. Herepath is entirely factual in his report and cautions only that care is required that the ether fluid should not be drawn into the lungs which would produce suffocation.

By 7 January a little sarcasm had crept into the *Times*. Drawing on the reports of amputations the following appeared[12]:

> 'A man may, it seems, have his legs out from under him without his knowing it, by the new process, whilst the drawing out of teeth becomes an agreeable excitement, which is so delightful that a boy having been mulcted of a molar, clamoured loudly to have another extracted.'

A feature of these early anaesthetics was the size of the audience both professional and lay, who witnessed them. On 15 January the *Times* reports:[13]

> 'There was a large concourse of spectators at St George's Hospital yesterday, to witness the administration of sulphuric ether to some persons who were to be subjected to surgical operations.'

Frequent visitors at these occasions included, Prince Napoleon Bonaparte, Lord Walsingham, Viscount Falkland, Lord Merton, Lord Dalmeny, Sir Henry Mildmay and Admiral Napier.

Factual descriptions may be found in the *Times* on 12, 21, 27 and 30 January, emphasising the importance of the new discovery and reporting lack of pain, though many of the patients were clearly aware of the procedure or experienced vivid dreams. After the flurry of the first six weeks, anaesthesia continued to be reported for some 20 years, but with decreasing frequency. There was one important change, in November 1847. In an article entitled: *Ether Superseded*, the *Times* reported from the *Edinburgh Mercury*, Professor Simpson's successful use of chloroform.[14] Subsequently, ether was hardly ever mentioned and anaesthesia became synonymous with chloroform.

Anaesthesia and Crime

Apart from reports of the early deaths, which are discussed separately, the only major caution to appear was the use of anaesthesia in crime. In an article which interestingly pre-dates the announcement of Simpson's use of chloroform in Edinburgh, the following appears:[15]

> 'Use of Chloroform by Thieves. Sir, Allow me through your widely-circulated journal, to caution the public against a new and most serious mode of attack which it appears the street robbers are now having recourse to, in order to effect their purpose more effectively without noise or power of resistance on the part of their victim. I allude to the use of chloroform, an instant of which occurred to a relation of mine on Monday 24th ult. An elderly gentleman passing through Chester Square at 8 o'clock p.m., was suddenly seized by the shoulders from behind by one man, while a second placed his hand firmly before his mouth; he almost instantly became insensible, and, on recovering from what he describes as an agreeable dream, found himself lying in the road, with a recollection of the attack, and of three men having been engaged in it. His purse, keys, spectacles, and gold eye glass were gone (the latter was brought to him by a policeman next morning, having been picked up on the pavement close to the spot); but the thieves had only ransacked one pocket and had left some money in the other, having doubtless been disturbed. The gentleman called the police, but none were near; he however soon met with assistance at the police station in the neighbourhood. Fortunately, the only personal injury he sustained was from a ruffianly grasp on his throat from which he suffered severely for several days, and on the night ensuing the attack was nearly suffocated, owing to inflammation and swelling of the windpipe. The public and the police especially, should be upon their guard against this alarming mode of attack, which, from the symptoms, must necessarily have been assisted by the use of chloroform, and which, under some circumstances, might have proved fatal.'

The *Times* returned to this theme in 1850. Two cases of robbery are described[16] in which chloroform was alleged to have been employed to render the victims insensible. In investigating the stories, the reporter could not find evidence to support the allegation. The article also asserts that chloroform could never be used without the express consent of the subject unless it was a child, and is perceptive in noting the length of time needed to render a subject unconscious especially as he might hold his breath. Despite this clear understanding, the notion of overcoming a victim with a volatile agent has persisted in popular fiction and film to this day.

Commercial Considerations

Mr Hooper was quick to avail himself of the potential financial advantages of the new discovery. On 16 January 1847 he advertised his apparatus in the *Times*:[17]

> 'AETHERIAL INHALER, constructed in accordance with Dr Boott and Mr Robinson's principle - Mr HOOPER has great satisfaction in stating, that at each of the metropolitan hospitals at which this apparatus has been used, it has succeeded in every case; at King's College by Mr Fergusson; at St Thomas's by Mr Murdy; at Westminster, by Mr Hale Thomson; at Guy's by Mr Morgan and Mr Aston Key. Independent of the first named, as well as at other hospitals, various apparatuses have been made trial of without producing the desired effect. Such being the case, it is of the highest importance it should be the most perfect construction. Mr Hooper begs to refer to any of the gentlemen here named. The apparatus will be supplied in rotation, as the orders are given.- 7, Pall Mall East, January 13th,1847.'

The fact that wider commercial possibilities were available is suggested by Ellis.[7] Of the letters that were sent from the United States to the United Kingdom describing ether anaesthesia, one was from a Boston patent lawyer, Robert H Eddy to James Dorr, an American lawyer living in London. Dorr received the letter on 16 November 1846 and contacted the Patent Agent, Moses Poole. Though a patent was apparently granted on 21 December 1846, events in Gower Street and at University College Hospital overtook the process.

The Early Deaths

Before Hannah Greener in January 1848 became the first unfortunate to die under an anaesthetic, three cases had occurred in the United Kingdom of death in association with anaesthesia - Thomas Herbert on 14 February 1847, Albinus Burfitt on 23 February 1847 and Ann Parkinson on 11 March 1847. Of these three cases, Ann Parkinson's is deserving of greater attention than has so far been given, since the Coroner's Inquest recorded this as the first death directly related to anaesthesia. The entry on her Death Certificate[18] states:

> 'Died from the effects of Ether administered for the purpose of alleviating pain during a surgical operation to remove an Osteo Sarcomatous tumour from the left thigh.'

Although in the medical press the deaths of Thomas Herbert and Albinus Burfitt are reported in association with anaesthesia, this specific fact is not mentioned on either death certificate.

The contemporary records of the Inquest into the death of Ann Parkinson do not survive in the local archives, but the events were widely reported in the medical, local and national press. The importance that was placed on the case by the Coroner, Mr G Kewney, is highlighted by his introduction to his jury reported in both the *Times* of 19 March 1847 and the *Lancet*:[19]

> 'The case you are about to investigate is one of the most important that it has fallen to my lot to preside over, because, if it should be found, after a calm and deliberate inquiry, that the death of this person did result from the effects of the vapour of ether, and not from the tumour under which she was labouring, or from the operation which was necessary to

> remove it, it will become a question, whether the person administering the ether is answerable for the consequences, or whether it is unsafe and prejudicial to life to pursue the practice of administering ether, which has been introduced apparently with great success in many cases.'

There follows a detailed report of the events and of the post mortem findings. In summing up, Mr Kewney states:

> 'That the deceased, Ann Parkinson, died from the effects of the vapour of ether, inhaled by her for the purpose of alleviating pain during the removal of a tumour from her left thigh, and not from the effect of the operation, or from any other cause.'

The surgeon, Mr Robbs, concurred with the verdict, and no case was brought against the anaesthetist Mr Dibden. In his discussion of the case, the Coroner did raise the possibility of criminal charges resulting:

> 'Although it would be hard to make medical men amenable to a charge of manslaughter because he happened to be unsuccessful in his treatment of any particular case, yet, on the other hand, it was necessary for the protection of the public that persons of the medical profession should understand that if they choose to make use of dangerous and deadly ingredients, they were bound to exercise the utmost care and caution in doing so. The interests of science required that there should occasionally be some departure from the beaten path prescribed by medical authority, and many important results had followed from such deviations by the alleviation of diseases heretofore deemed incurable. But if dangerous experiments were attempted, the persons adopting them must be taught to keep within proper bounds, and that they must exercise the most ample caution in carrying out those experiments.'

Parliament

With this new humanitarian advance, and its apparent drawbacks including the death of patients, attention might have been expected from the Parliament of the day. However, examination of *Hansard* and Parliamentary Papers turns up little which is not already known. In 1856, the Select Committee on the Adulteration of Food took evidence on the purity of chloroform from Lindsey Blyth, analytical chemist and Lecturer on Natural Philosophy at St Mary's Hospital Paddington.[20] The record of chloroform usage in the Crimean War is to be found in an 1854 entry.[21] Sir John Hall cautioned against its use in the severe shock of gunshot wounds. This dictate was also published in the *Illustrated London News*:[22]

'Dr Hall takes this opportunity of cautioning medical officers against the use of chloroform in the severe shock of gunshot wounds, as he thinks few will survive where it is used. But as public opinion, founded perhaps on mistaken philanthropy, he knows is against him, he can only caution medical officers and entreat they will narrowly watch its effect: for however barbarous it may appear, the smart of the knife is a powerful stimulant: and it is much better to hear a man bawl lustily than to see him sink silently into the grave.'

Parliament's apparent indifference was not the fault of the lay press, which had been quick to alert Members to the possibilities of anaesthesia. As early as 7 January 1847 the *Times*,[12] reporting from *Punch* was acerbic:

> 'However desirable this invention may be in a surgical point of view, we have every hope that it will soon be applied to the more delicate operations of politics. How useful would it have been during the last session, when the Conservative body had to undergo the painful process of the cutting off of so many members! Had the new process been known, the political amputations might have taken place without any pain, amounting in some cases to direct mortification, which ensued in several instances. Considering the frequent severings that Sir Robert Peel has been obliged to undergo, and the numerous occasions upon which he will again most probably feel it necessary to submit to amputations, the new process must be almost invaluable to the right hon. Baronet. As the plan is calculated to prevent pain in all cases of removal, we should recommend its being tried on the next occasion of a removal from office by Her Majesty's Ministers. This has always been a most distressing operation, from the suffering it has inflicted on the parties concerned; and all the friends of humanity must be delighted at the prospect there is of its becoming an entirely painless proceeding.'

Punch also suggested the use of chloroform for electioneering:[23]

> 'It appears that the Yarmouth votes - whom from their vendible nature, we might venture to call Yarmouth bloaters - disposed of theirselves, at the last election, at the rate of £3 a-head. A parliamentary inquisition has declared the members returned, LORD ARTHUR LENNOX and OCTAVIUS EDWARD COOPE Esq., not duly elected, adding, however, that there is 'no evidence to show' that these acts of bribery were committed 'with the knowledge and consent' of the gentlemen in question. For the candidates' extraordinary unconsciousness of the proceedings of their Committees, we can account only on one supposition, namely, that during the election they were under the influence of Chloroform.'

Religious Objections

In 1848, Sir James Young Simpson published his *Answer to the Religious Objections advanced against the Employment of Anaesthetical Agents in Midwifery and Surgery*.[24] He maintained that patients and professionals had joined in opposition on religious grounds, particularly Genesis **3**,16: 'Unto woman he said, I will greatly multiply thy sorrow and thy conception; in sorrow thou shalt bring forth children; and thy desire shall be to thy husband, and he shall rule over thee'.

A search of the religious literature and sermons of the period provides little evidence to support any extensive opposition to anaesthesia. There were many religious pamphlets at that time such as the *Church of England Review*, *Christian Remembrance*, *Wesley Methodist Review*, *Christian Examiner*, and the *Jewish Intelligence* (for promoting Christianity amongst Jews), but they are resolutely silent on the subject of anaesthesia. Only in the *Christian Reformer* of 1848 can a single article be found.[25] This piece largely reports on the publication of James Young Simpson's 'Answer', and is entirely supportive of anaesthesia. However, it does add evidence furnished by a well known Scottish poet, Mr Gillpillan, about

a clergyman debarring from communion of the Lord's Supper those members of his flock who have irreverently used the 'Devil's Wind'. It also quotes from *Old Mortality* by Sir Walter Scott, where honest Mause Headrigg charges Lady Margaret Bellenden and the authorities of Tillietudlem with abetting this reprehensible practice. Farr,[26] in his examination of early opposition to obstetric anaesthesia, feels that Simpson's pamphlet was written to forestall objections which then did not arise.

Queen Victoria

On 7 April 1853 Dr John Snow administered chloroform to Queen Victoria during the birth of Prince Leopold. Connor and Connor[27] have examined the effect this had on the general acceptance of the technique. They conclude that this use of chloroform was largely ignored by the lay press, so although some members of the public would be aware of it, many were not. In those papers that did report, no subsequent correspondence appeared on the subject. From John Snow's casebooks, though his anaesthetic work steadily increased, the obstetric part of his practice did not show any significantly greater rise following this royal attendance.

Who received anaesthesia?

By no means all patients benefitted from the introduction of anaesthesia. Because of the dictate from Sir John Hall and because of difficulties in the supply of drugs, perhaps as few as 66% of soldiers were given anaesthesia for amputations in the field during the Crimean War. In America, as has been mentioned, slaves were viewed as having a different reaction to pain. Pernick[28] further reports that in the Massachusetts General Hospital during the first year of anaesthesia one third of operations took place without it. Indeed the first harelip operation under anaesthesia at MGH was not until 1855. A similar pattern is found at the Pennsylvania Hospital where between 1853 and 1862 one third of male amputations did not receive anaesthesia. Age, sex, race, type of operation, social condition, intemperance, infirmity, specific disease, soldiering and bullets wounds all seemed to have influence over the decision whether to employ anaesthesia.

Humour

The subject of anaesthesia was not immune to humour. The *Punch* cartoon[29] from which my title is taken appeared in 1847.

Punch had some further interesting speculations. Butchers, shoe shops and barbers were among many areas suggested as benefitting from the use of anaesthesia:

> 'We understand that the inhalation of ether has been resorted to, professionally, by various pork butchers with great success. The chief difficulty they have experienced has consisted in the opposition of the patient; but when the natural obstinacy of the pig has been overcome, and he has been persuaded to inhale the ether, he has been killed with comfort to himself, and without disturbance to the neighbourhood.'[30]

> 'The *Globe* states that some successful experiments have recently been made in France on the etherization of bees, so as to be able to take their honey whilst they are in a state of inaction, without the necessity of destroying their lives. It is much to be wished that some

Fig 1

process could be invented for the etherization of the British Bee, which, in a state of industry, feels the subtraction of its honey most acutely. Would that a species of etherization could be devised which would render JOHN BULL insensible to the operation of Income Tax!'[31]

'In a shop of the benevolent and poetic TAYLOR, of Lombard Street, there is - we learn from a correspondent - this benign notice:- 'Oysters opened, and their beards taken off, under the influence of Chloroform!' A greater wonder, however, is achieved at Billingsgate; and, in the words of our correspondent (evidently a female): 'they are skinned, and know no more of having their coats taken off than a 'toxicated husband'. The simile is alike flattering to eels and husbands.'[32]

'We think that this valuable invention is too much limited in its application, for there are thousands of circumstances of every-day life, in which, if insensibility could be produced, the good effect would be obvious. It is not everybody who stands in need of a surgical operation, and the restriction of chloroform to matters of the kind is consequently a great curtailment of the advantages of the new discovery. We are sure that if Chloroform were always sold with new boots, it would greatly add to the comfort of trying them on; and 'Chloroform for easy shaving' would be a popular announcement in the window of any barber. In schools where the archaic practice of flagellation still prevails, if it is only the warning and disgrace that are the objects of the brutal ceremony, the use of chloroform would redeem the operation from the charge of cruelty, without depriving the punishment of its assumed efficacy on the grounds specified.'[33]

The first staging of anaesthesia may not belong with medical men like Snow or Guedel, but with the fictional character of Cimabue Potts in a *Punch* article of 1847 entitled: *Ethereal Experiences*:[34]

'PUNCH is credibly informed that the use of ether is superseding that of alcohol for the production of 'agreeable excitement'. The ladies, who used to patronise the gin-shop, now drop in at the chemist's to call for their 'ounce of Ether and a suction-pipe', instead of the classical 'quartern and three outs'.'

'We have made inquiries into the subject, and have received several communications corroborating the fact, and describing the effects of the new stimulant:

No.1 - From CIMABUE POTTS, Historical Painter:
'Sir,- I have imbibed Ether, and shall continue to do so till I have painted a work destined for immortality, which I confidently expect to do next week. I subjoin what I remember of my feelings during the ethereal state.

First stage. Imagined myself in Rome, in company with RAFAELLE. MR.ETTY (R.A.), and the editor of Art-Union, the latter in chains, and trampled upon by us in succession. (you are aware I have been the butt of his malignant criticism for years).

Second stage - Felt immortal, and was congratulated by the daily and weekly papers.

Third stage - Produced an historical picture, 25 feet by 15, representing the discovery of the dead body of Harold after the Battle of Hastings; received the premium of £700 from the Fine Arts Commissioners, and was dragged home by the populace in my own carriage!

Last stage - Recovered and found myself, with the bladder empty, in the Goose and Gridiron.

You may make use of any of the inclosed: my enemies will understand the allusions.'

Finally, the credit for the first poem or song relating to anaesthesia may also belong to *Punch*:[35]

The Blessings of Chloroform
AIR "Run Neighbours, Run," &c

OH! what a host, when an infinite variety,
Rapt Imagination, in her transports warm,
Pictures of blessings conferr'd upon society,
By the new discovery of Chloroform!
Applications, amputations, denudations, perforations,
Utterly divested of all disagreeable sensations;
Like your coat-tail in a crowd - some clever cut-purse stealing it-
Arms and legs are now whipp'd off without our feeling it.

Take but a sniff at this essence anaesthetical,
Dropp'd upon a handkerchief, or a bit of sponge,
And on your eyelids 'twil clap a seal hermetical,
And your senses in a trance that instant plunge.
Then you may be punch'd and punctured, bump'd and thump'd and whack'd about
Scotch'd, and scoured, and lacerated, cauterised and hack'd about:
And though tender as a chick - a Sybarite for queasiness -
Flay'd alive, unconscious of a feeling of uneasiness.

CELSUS will witness our deft chirugeons presently,
Manage operations as he said they should;
Doing them "safely, and speedily, and pleasantly,"
Just as if the body were a log of wood.
Teeth, instead of being drawn with agonies unmeasurable,
Now will be extracted with sensations rather pleasurable;
Chloroform will render quite agreeable the parting with
Any useless member that a patient has been smarting with.

Then what vest, of what wonderful utility,
View'd in its relation to domestic bliss,
Since, in a trice, it can calm irritability,
Surely such a substance will be found as this!
Scolding wife and squalling infant - petulance and fretfulness,
Lulling, with its magic power, instanteur, in forgetfulness,
Peace in private families securing, and in populous
Nurseries, when'er their little inmates prove "obstopolous."

When some vile dun with little bill is vexing you;
When the Tax Collector's knock assails your door;
When aught is troubling, annoying, or perplexing you;
When in short, you're plagued with any kind of bore,
Do not rage and fume and fret, behaving with stupidity,
Take the matter quietly with coolness and placidity;
Don't indulge in conduct and in language reprehensible -
Snuff a little Chloroform, be prudent, and insensible.

In Conclusion

Society in 1846 was very different from that of today. Slavery was still accepted in some States in America, and child labour was normal in the United Kingdom. Against this background, the humanitarian advance of anaesthesia was made. Study of the lay reaction is made difficult by the fact that not all sections of the community were literate even by the standard of being able to sign their name.

The early press reports were generally supportive of the discovery but mainly factual in their descriptions of the event; very seldom would a clear opinion be expressed. The mesmerists were an exception, being wholeheartedly in favour of ether anaesthesia, and derogatory to the medical profession for not having already woken up to the concept. The only cautions were firstly about the early deaths when, perhaps for the first time, the possibility of a manslaughter charge against an anaesthetist was raised by the Grantham Coroner in the case of Ann Parkinson; secondly, concern about the use of chloroform for criminal purposes, but these stories were not supported by the evidence of investigative journalists.

In the press, soon after Simpson's publication of November 1847, anaesthesia apparently became synonymous with chloroform. Though religious objections to anaesthesia did exist, especially in the area of labour and childbirth, these were few and did not carry much written support. The use of chloroform by Queen Victoria for childbirth seems not to have been widely reported and did not have much influence on public opinion.

I could find no evidence of major debate about anaesthesia within the press, Parliament or the Church. To place the reporting in perspective, while articles about anaesthesia appeared sporadically over the twenty years following its introduction, other matters carried much more weight. For example in the quarter from 1 July to 30 September 1866 there were over 200 articles relating to the cholera epidemic, whilst between 1 January and 31 March 1847 over 400 bankruptcies were announced in the *Times*. These examples are perhaps not surprising given the nature of contemporary society, and give added consideration to the reasons why anaesthesia took so long to be discovered.

Finally, anaesthesia was subjected to the humour of the day, with many enjoyable articles to be found in publications such as *Punch*.

Acknowledgements

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BOTTLES, BAGS AND BOWLS

Dr D J Wilkinson
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Hon. Secretary, Association of Anaesthetists

In the week before Christmas 1846, Francis Boott received a letter from his friend Jacob Bigelow in Boston, containing news of an astonishing nature. A dentist called William Morton had used ether to produce a state in which surgery could be performed painlessly. This event had transpired on October 16th 1846. What should Boott do? He could not ring for more information or fax his friend in America nor could he e-mail for clarification. He could only sit and wonder at this concept. But Bigelow had written to someone who would do more than think; he would act. Boott contacted his friend James Robinson, a dentist who lived down the road in Gower Street, and they went to Hooper's Apothecaries shop in Pall Mall to enquire about ether and to consider some apparatus through which it could be delivered to a patient. Here was the next challenge. There were no anaesthetic machines to modify, no Boyle's apparatus, dropper bottles or masks; how should they proceed?

Ether vaporisation

Inhalational therapy for disease was not a new concept. Mudge's inhaler was introduced in 1788 and was used by asthmatics and others with chest problems to inhale steam, or herbs such as balsam with the steam. Nelson's inhaler was of a similar nature. Neither of these were employed by Robinson or Boott although both devices had probably been used in the past to deliver ether vapour in steam, since it was widely used for chest complaints. No-one took up the idea of anaesthesia from any of these supposed occasions. Inhalation for recreational purposes was also well known, and ether frolics were popular with undergraduates both in the UK and on the continent. A wide variety of simple bowls and bottles were used for this purpose. William Clarke had used ether anaesthesia in January of 1842 in Rochester, New York, and Crawford Long in Jefferson, Georgia some two months later had similar success with just a small towel as his sole vaporiser. However, no one in the UK was to know of these events for several years, so again they did not influence Boott or Robinson.

Morton's inhalers

In New England, Wells's work with nitrous oxide had utilised a simple gas-bag and mouthpiece, so when his ex-pupil and partner Morton began to experiment with ether he, too, had to start anew. The first anaesthetic he gave was to Eben Frost on 30 September 1846. He used a simple handkerchief and a sketch in Nathan Rice's *Trials of a Public Benefactor*[1] shows him giving ether while a friend holds a lamp close by to provide illumination; ether is not too explosive in air! Morton then tried a simple glass sphere, more of a bowl than anything else, with two openings, one of which was fitted with a simple spigot through which the patient could inhale, the other allowed the entry of room air. The vaporiser was made by a Mr Wightman, a local instrument maker, who believed that if this device worked then a better model could be made. He increased the vaporising surface by adding a sponge to the inside of the bowl and the apparatus worked well. (Figure 1)

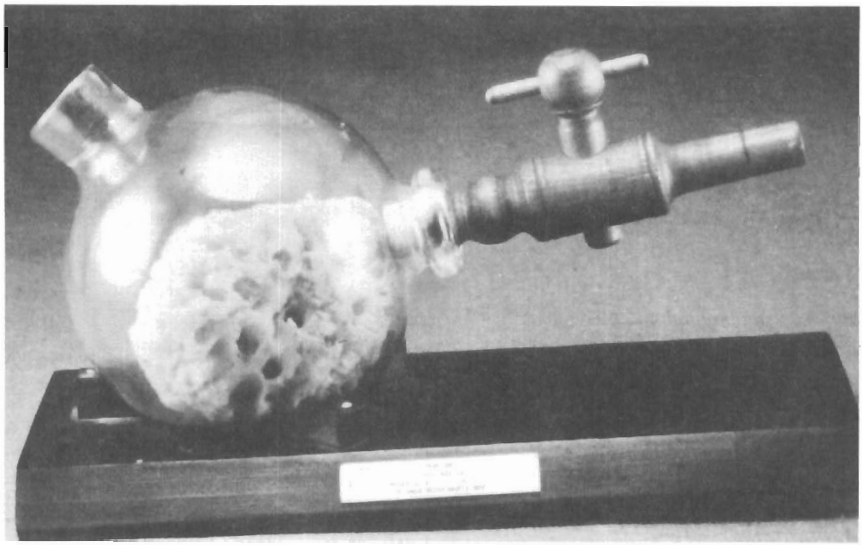

Figure 1. Replica of the first Morton ether inhaler

Then on 14 October, Warren invited Morton to demonstrate ether anaesthesia in two days time at the Harvard Medical School. Morton decided to invest in a new vaporiser. He developed an apparatus with a third aperture to which was fitted a cork into which grooves were cut and added a dropping tube through which more ether could be supplied. These modifications were an improvement but Morton was still not satisfied. He is said to have sat up late into the night with a Boston physician, Dr Augustus Gould, and from their discussions evolved a new inhaler with valves in the mouthpiece and air inlet. This was the new vaporiser that he brought to the momentous public demonstration on 16 October 1846. Made by a different instrument maker, a Mr Chamberlain, it had a long mouth tube through which the patient breathed, his nose being pinched shut with a clip or by the administrator's fingers.

This rapid sequence of vaporisers has seemingly caused some confusion. The replica of Morton's inhaler sent to the Association of Anaesthetists by the New York Society of Anaesthetists in 1950 has a spigot and no valves;[2] the Smithsonian has a device called Morton's First Inhaler or the Wiksell exhibit which is similar and which is illustrated in Gwathmey's textbook of anaesthesia.[3] This device I believe is the one that Morton used in his initial experiments in his rooms after the idea of a vaporiser was born from his first work with a simple cloth. The Wood Library-Museum and the Ether Dome have vaporisers with valves but no dropper for adding ether, which I believe was the vaporiser used on 'ether day', while Duncum's book shows the later modification with ether dropper[4] of which I understand no example remains today. (Figure 2)

Boott and Robinson's inhaler

Why did Boott and Robinson select the apparatus they did at Hooper's of Pall Mall? They chose this apparatus because of the information they were sent from Boston; for as well as

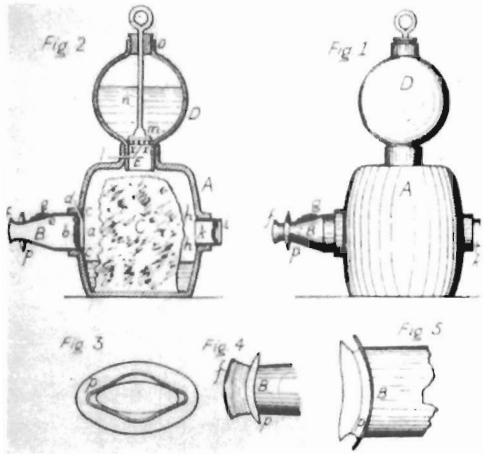

Figure 2. Morton and Gould patented ether inhaler

his letter, Bigelow enclosed a cutting from the *Boston Daily Advertiser* in which his nephew Henry Bigelow describes Morton's apparatus in detail:

> 'A small two necked glass bowl contains the prepared vapour, together with sponges to enlarge the vaporising surface. One aperture admits air to the interior of the globe and whence charged with vapour it is drawn through the second to the lungs. The inspired air passes through the bottle but the expired is diverted by a valve in the mouthpiece and by escaping into the apartment is thus prevented from vitiating the medicated vapour.'

These details were published in the *Lancet* when Boott reported the success of Robinson's work.[5] Valves in medical apparatus had been present for some time. In 1820, John Read had patented an improvement in syringes which used ball valves which were in turn modified and applied to other medical equipment. One description of the early ether inhalers refers to the mouthpiece as Read's flexible inhaling tube.

Morton's apparatus was perhaps more convenient than that devised by Hooper who used part of a Nooth's apparatus which had been designed for carbonating water. Morton's vaporiser was relatively small and could be held in one hand while the larger Hooper's apparatus needed to be placed on a table. (Figure 3) When Robert Liston was invited to see this new method of pain relief he turned to the instrument maker Squire who made another modification of a Nooth's apparatus for his nephew to use at the North London Hospital on 21 December 1846 to anaesthetise Frederick Churchill while Liston performed an amputation. (Figure 4) Further experiments with this new apparatus were not always satisfactory and the cumbersome design often resulted in their being abandoned. The forced mouth breathing and pinching of the nose were found to be most uncomfortable by some patients (although presumably this was relative in comparison to the pain that the operation would have otherwise engendered!).

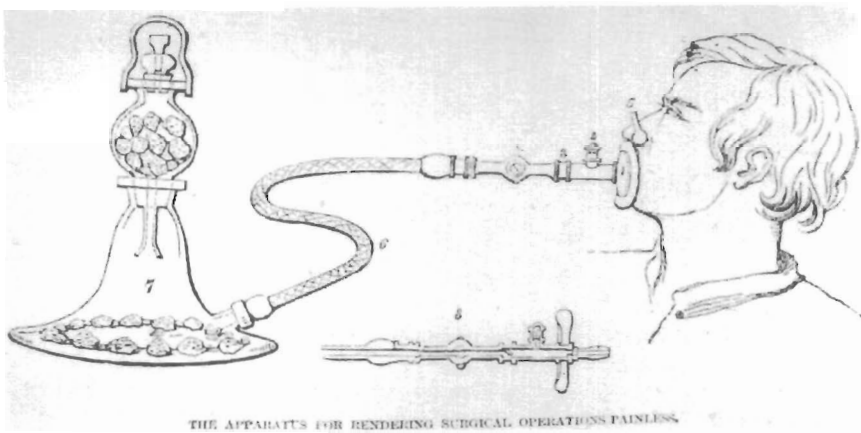

Figure 3. Hooper's ether inhaler

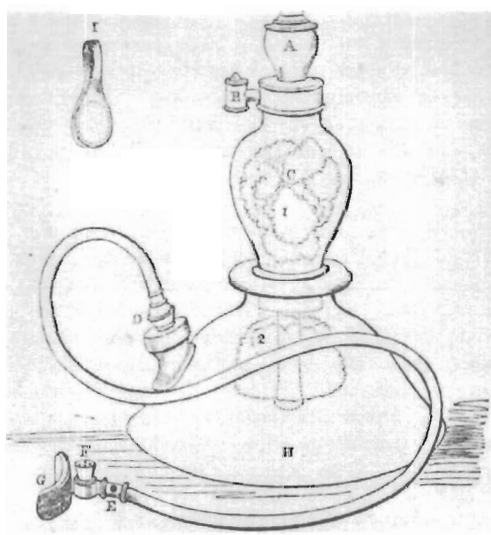

Figure 4. Squire's ether inhaler

Continental apparatus

In France on 12 January 1847 Malgaigne reported five anaesthetics given through a simple tube introduced into one nostril; he blocked the other nostril and instructed the patient to breathe in with his mouth closed and then exhale through the open mouth. The patients learnt to do this quite well apparently, and the inference must be that they retained some degree of co-operation throughout their surgery and were merely rendered pain-free but not deeply unconscious. This work in Paris encouraged others to try similar techniques. Landouzy in Rheims had an apparatus consisting of two nasal tubes, the free ends of which hung in a jar of ether. Roux, another Paris surgeon, decided to follow the British practice and used a flask containing an ether-soaked sponge. A more complex vaporiser was made by the instrument mmanufacturer, Charrière, which had inspiratory and expiratory valves and a simple mouthpiece. (Figure 5)

Robert Ritter von Welz, an ophthalmologist in Wurzberg designed a different apparatus in July 1847. Made of wood and horn it had inspiratory and expiratory valves and could be used with a mouthpiece or nasal tubes.[6] Diffenbach in Berlin had a vaporiser with a long gum elastic mouthpiece and no valves which must have created a significant dead space.

Not all attempted anaesthetics were successful and the surgeons at this time were not sure whether failures were due to the apparatus used or whether the whole concept was invalid. More and more pieces of apparatus developed, each with a suggested refinement.

Figure 5. Charrière's ether inhaler

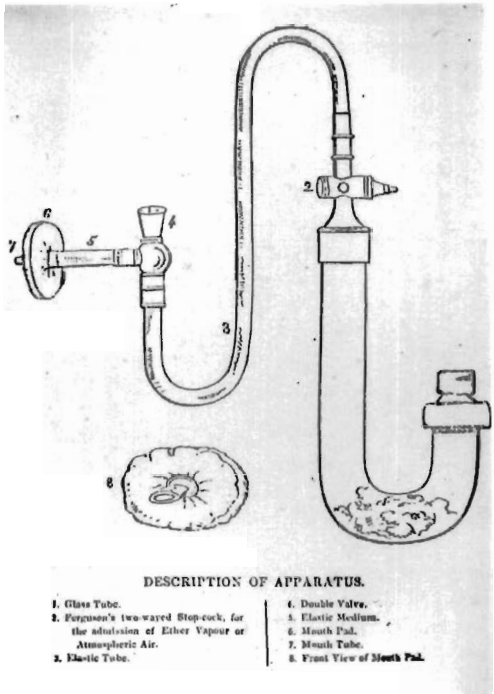

Figure 6. Tracy's inhaler

More efficient vaporisers

Samuel John Tracy at Barts designed a beautiful curved 'hookah' glass tube which was filled with ether and connected with a brass tube to a Read's breathing tube. Tracy described its use in over 500 dental extractions without problems and noted that inspiration was indicated by the movement of the liquid ether in the tube. (Figure 6) He observed that the temperature of the ether fell during its use from 62^{O}F to 50^{O}F within five minutes and that the output of the vaporiser changed from 41.4% ether to 31.2% during the same time. He advocated warming the tube either in the hand or with a warm sponge to improve efficiency. Tracy wrote that he considered his vaporiser the best available and certainly superior to a tin one he had observed which caused such a rapid evaporation of the ether that the patients could not tolerate it.[7,8] This description was probably of a Smee Inhaler which was made of tin and had a reservoir of hot water in its lower third. The *Illustrated London News* depicted another vaporiser which it labelled a 'graduated-dose inhaler' because the concentration of inhaled ether could be altered by the opening or closing of a variety of air bypasses. In March 1847 Hoffman of Margate described his inhaler in which he placed the air inlet below the level of the liquid ether so that the patient's inspiratory efforts caused the inhaled air to bubble through the liquid ether. The whole vaporiser could be immersed in hot water or alternatively heated directly with a spirit lamp! A Hedley ether inhaler from Bedford was made entirely of wood to prevent freezing of the apparatus but it is unclear whether this was developed

commercially. Bell's apparatus had a glass mouthpiece to facilitate cleaning and the valves were made of small glass discs.

Return to simplicity

Because all the bottles with their valves and tubes were both expensive and fragile many anaesthetists moved back to simpler devices. Tracy advocated the use of a simple ether-soaked sponge held close to the patient's face. Some poured a little ether into a bladder and placed that close to the face. Roux in France took this one stage further with his 'sac' which was placed completely over the patient's head and the strings drawn tight around the neck. (Figure 7) The patient then breathed through the nose and mouth and although there was total rebreathing this apparatus proved quite popular. The whole sac was placed in hot water before use to vaporise the ether (a distensible Pinson Bomb!!) and more liquid ether could be added during use if required.

Francis Sibson was working at the Nottingham General Hospital when he devised a combined mouth and nosepiece which is the precursor of the facemasks in use today. (Figure 8) John Snow rapidly adopted this huge improvement and modified it for his ether inhaler which combined many of the developments described in the literature to date together with some refinements of his own. This inhaler is always cited as a milestone but in fact was the result of the development of a whole series of inhalers and was not in itself a particular 'commercial' success as judged by the absence of the survival of many examples to the present time.

Introduction of chloroform anaesthesia

When Simpson introduced chloroform anaesthesia in November 1847 he initially used a sponge or piece of linen but soon adopted what became known as the Edinburgh method which was to fold a handkerchief into a cone which was placed over the patient's nose and mouth with the chloroform dropped slowly onto the apex of the cone. It would appear that this simple 'apparatus' was not enough for some practitioners and a new series of special chloroform inhalers evolved. Francis Sibson designed an inhaler based on the Snow ether mask and Charrière in Paris developed a very sophisticated inhaler with inspiratory and expiratory valves.

Snow designed his own chloroform inhaler which was the first to incorporate a water jacket and a sight guide to the volume of liquid chloroform retained in the vaporiser. (Figure 9) The vaporisation in this apparatus was further enhanced by the use of special wicks made of blotting paper. Snow's accurate measurement of the delivered concentration of chloroform in air indicate the meticulous scientific methods which typify his whole career. With a water-bath temperature of 60F° a concentration of 5% chloroform was obtained which was diluted by allowing air entrainment at the facepiece during inspiration.

More and more inhalers were introduced at this time, some highly ornate; others, like that of Coates from Salisbury, were developments from earlier apparatus. Soon every practitioner had either adopted a manufactured device or was trying to encourage the use of his own inhaler and the literature of this era has hundreds of such new inventions. Many of these

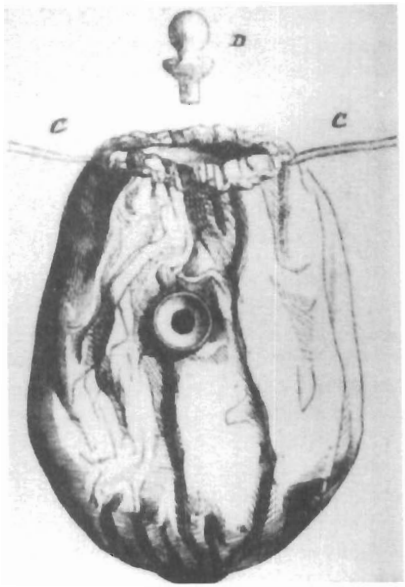

Figure 7. Roux's sac

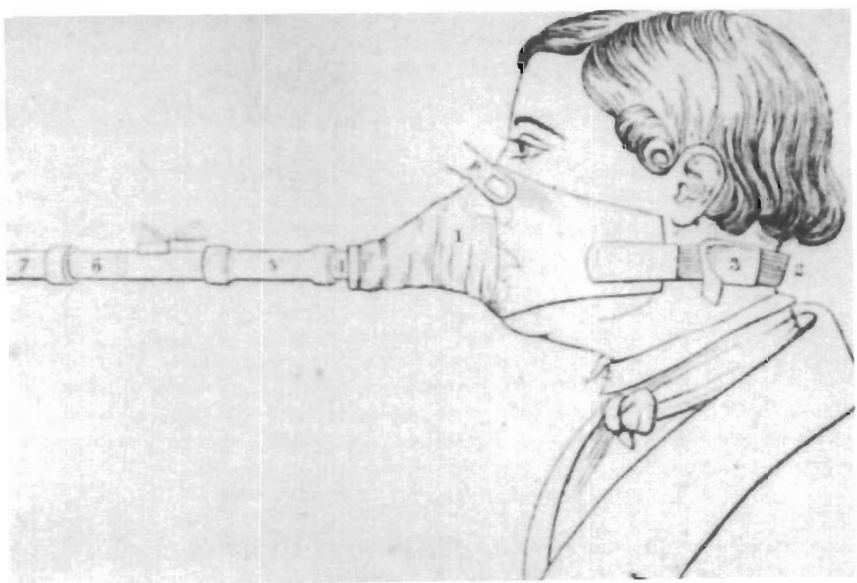

Figure 8. Sibson's mask

survived to the present day and can be seen in museums but others are perhaps still awaiting re-discovery in attics, junk shops and cupboards across the country.

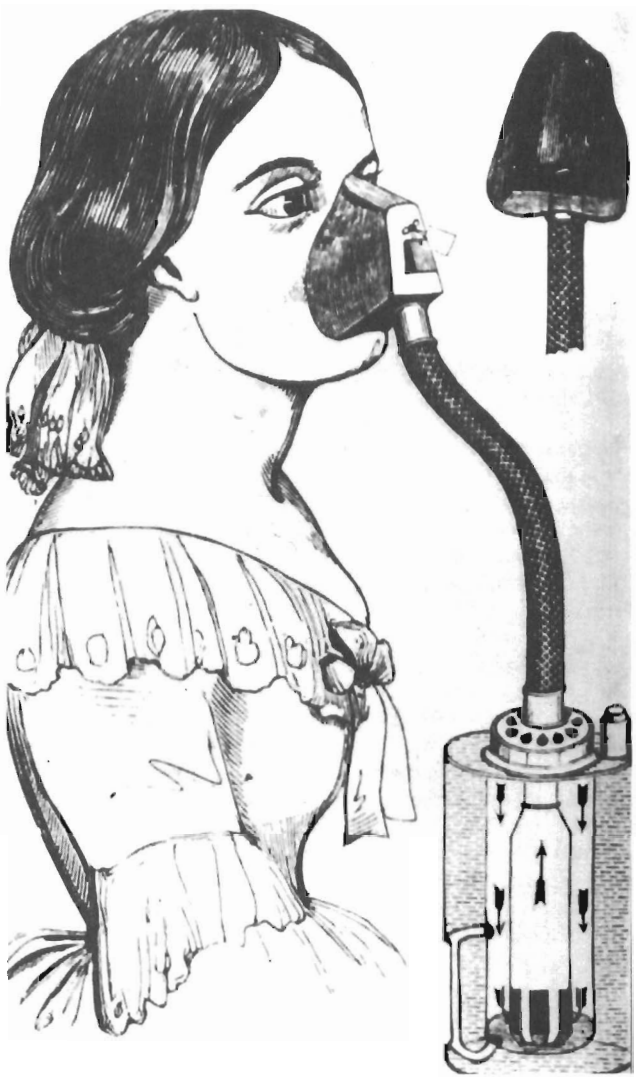

Figure 9. Snow's chloroform inhaler

The wire-frame mask

In 1862 the Liverpool obstetrician Thomas Skinner developed the first wire frame mask.[9] Covered by a simple layer of lint it was easily cleaned and the lint could be replaced for each new patient. His particular device could be folded up and carried inside his top hat. The apparatus was well received at the time but did not immediately prove very popular. Indeed, some 11 years later, Skinner wrote a letter to the *British Medical Journal* deploring the continued use of inhalers:

> 'If there be one evil more crying, more disgusting than another, in the practice of inducing anaesthesia it is in the use of inhalers. There is not one inhaler where every patient is not made to breathe through the same mouthpiece tube and chamber. Sweet seventeen is made to follow a bearded devotee to Bacchus, saturated with the smoke of cigars and the exhalations of cognac; or another whose nasal and pulmonary mucous membranes, leave alone the cutaneous surroundings of the mouth and nares, may be exhalant of all odours but those of purity and innocence, and when looked into may be found sensible to sight as well as smell. The mouthpiece in time becomes loaded with grease and filthy enough to upset anyone's digestion and sleep for a considerable time to come. After 25 years experience we remain the merest barbarians, everyone breathing after his neighbour.'

A series of wire-frame masks were developed, all having their own refinements. The most famous of these is the Schimmelbusch mask with its trough to allow the collection of excess liquid anaesthetic agent and the bi-concave shape of its oval facepiece.[10] Others introduced such niceties as the ducting of oxygen to the mask and the addition of special funnels to aid the pouring of the ether or chloroform. Soon there were as many masks as there were inhalers, and because of their more robust nature many more of these remain as a rich resource for the historian.

New methods of administration

In 1867, Ferdinand Junker introduced the concept of insufflation anaesthesia with his ingenious bottle of chloroform through which air was blown onto the patient's face by the squeezing of a rubber bulb by the operator.[11] The initial apparatus was very dangerous if connected up incorrectly and deaths occurred when liquid chloroform was 'blown' into the pharynx. Subsequent modifications of the inhaler retained the principle of insufflation but incorporated a series of safety devices to prevent mis-connection. These portable, simple inhalers proved very popular.

Thomas Clover had introduced his chloroform bag in 1862 which when constructed according to his instructions produced a large volume of 4½% chloroform in air, held in a huge reservoir bag on the anaesthetist's back and fed through a small tube to a mask. This did not prove very popular - unlike his simple portable regulating ether inhaler of 1877.[12] This effective, but physiologically unsound, vaporiser was soon in use all over the world and led to a large series of modifications like the Hewitt and Ombredanne Inhalers. Its main disadvantages were rebreathing and the inability to allow air or oxygen to the patient without removing the inhaler from the patient's face. The Ombredanne inhaler which solved many of the imperfections of the Clover device proved tremendously successful, especially in Europe and South America and was still in use late in the 20th Century.

Later developments

Modern anaesthesia has evolved from the introduction in the 20th century of continuous flow apparatus. The adoption of watersight flowmeters by Gwathmey into a simple ether apparatus in 1912 was taken up by Boyle in 1917 [13] and subsequent apparatus in the UK has evolved from this. In Europe a large proportion of innovation has come from the Dräger Company in Lubeck but often political events prevented their designs receiving more widespread acceptance. Hand in hand with progress in continuous flow equipment has been the development of draw-over vaporisers for use in environments without compressed gases.

In more recent times a monitoring revolution has swept through anaesthesia. Much monitoring apparatus has been incorporated into anaesthetic machines, thus increasing their complexity and size. Most of the simple devices of our forefathers worked well in the era into which they were introduced. They have been replaced by the electronic gadgetry of today, but history shows us that most developments last for just a short period of time. Future generations may look upon our complex machines with the same incredulity and perhaps amusement with which we regard the bags, bottles and bowls of the past.

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EMPIRICISM AND EXPERIMENT: PHARMACOLOGY

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In the early part of the nineteenth century the use of drugs in medicine was based upon observations made in the course of practice. An awareness that empiricism too often resulted in false theories is evident in the 4th edition of *Pharmacologia* by John Ayrton Paris (1785-1856) who became President of the London College of Physicians and held that office at the time anaesthesia with ether and chloroform was introduced. Paris wrote in 1820 of physic being arraigned as a fallacious art, and asked when in the history of remedies have we been able to produce a discovery which has been the result of those methods which have 'so eminently rewarded the labours of modern science'?[1]

Early studies

A number of experimental studies involving potent substances had been reported in the late eighteenth century, some of which had resulted in advances being made in physiology and toxicology. Examples include studies with opium by Albrech von Haller (1708-1777), with alcohol and opium by Alexander Monro Secundus (1733-1817) and the controlled experiments on viper venom, opium and curare arrow poisons by Felice Fontana (1730-1805).[2,3] Experiments with alkaloids isolated from drugs whose medical use had been empirically determined were carried out by Francois Magendie (1783-1855) and others in the early decades of the nineteenth century. These studies revealed the nature of the physiological and toxicological action of morphine, strychnine and other alkaloids, thereby assisting their introduction into therapy.[4]

Confidence that results obtained in experiments with animals were valid when applied to man was not universally shared. It was generally accepted that physiological responses observed in animals were similar to those in man but this did little to advance knowledge of the use of a drug in disease. J A Paris was unable to envisage any improvement in drug therapy arising from the experimental methods of science because, in his opinion, the physician faced problems unavoidably embarrassed by complex and fluctuating circumstances.[5]

The anaesthetics introduced into medicine in the mid-nineteenth century were associated with physiological responses readily amenable to both empirical and experimental methods of study. The results thus obtained contributed greatly to the use of ether, chloroform and other narcotic substances in surgery but failed to reveal their mode of action. John Snow (1813-1858), whose writings indicate his appreciation of the role of scientific principles in the safe and successful use of anaesthetics, took an interest in 'the intimate nature of the phenomena' and his speculations concerning the *modus operandi* of narcotic vapours reveal something of the nature of pharmacological theory in the mid-nineneenth century.

Vital principle or chemical reaction?

Pharmacodynamic explanations are subject to advances in physiology. Magendie's researches into venous absorption coupled with contemporary physiological research, notably the studies of haemodynamics by J L M Poiseuille (1797-1869), contributed to knowledge

concerning the absorption and distribution of drugs.[6,7] Magendie's demonstration that strychnine was carried in the circulation to act selectively on the spinal cord raised the question of how a potent substance circulating in the blood and bathing all the organs could act selectively on just one. Two forms of explanation appeared in the literature: interpretations involving a vital principle and theories based on physical or chemical reactions.

The eminent chemist, Justus von Liebig (1803-1873) believed chemical explanations would lead to a clearer comprehension of the action of remedies. In *Die Thierchemie* of 1842, which was translated into English the same year, Liebig pointed out that alkaloids were material, ponderable and tangible. A double dose of the substance acts more powerfully than a single dose. These, and other considerationis 'viewed chemically', suggested that these compounds, by means of their elements, take a share in the formation or transformation of existing brain and nervous matter.[8,9]

Not everyone agreed. There was the vitalist argument that the 'vital principle' which maintains the harmony and integrity of the organism must, by its very nature, resist chemical changes in the internal fluids.[10] On the other hand, there were objections from people who, although sympathetic to the chemical argument, were suspicious of Liebig's excessive speculations. Jonathon Pereira (1804-1853), who was revising his encyclopaedic *Elements of Materia Medica and Therapeutics* at the time the anaesthetics were introduced, pointed out that substances with differing chemical natures induced similar physiological response. Pereira does not cite the anaesthetics, but nitrous oxide, chloroform and ether are prime examples.

This was one of several arguments that led Pereira to conclude that 'neither physics nor chemistry appear to be capable of furnishing a satisfactory explanation of the specific effects of medicines which, therefore, must be referred, at least for the present, to peculiarities in the vital endowments of particular parts [of the body]'.[11] At this time it was believed that there were living phenomena which could be attributed only to the action of a vital principle and were beyond enquiry, and those which were the outcome of chemical or physical causes and might be studied by experimental methods.[12]

John Snow's theories

In 1842, John Snow observed that 'chemical affinity' and 'vitality' were expressions useful in the infancy of science but as yet they had no separate or defined existence.[13] Five years later, when he came to consider the mode of action of ether and chloroform, he opted for chemical affinity as an explanation. It is possible to identify two factors leading to Snow's theory of the action of anaesthetic substances. The first was that since 1842 his mind had been focused upon changes in the capillary blood as an explanation for the action of certain types of medicine. The second related to recent studies in the field of oxygen metabolism coupled with the influence of Liebig's theories.

In 1842, Snow published an article under the title 'On the circulation in the capillary blood vessels and on some of its connections with pathology and therapeutics'. In it he asserted that, in addition to the action of the heart, movement of blood is assisted by mutual changes taking place between the blood and tissues which are attended by 'attractions and repulsions'.

He went on to explain the action of the antispasmodic dugs, one of which was ether. Noting that these medicines (ether, camphor, asafoetida and essential oils) were all of a volatile nature, he speculated that the antispasmodic medicines were absorbed into the circulation, then separated from the blood in the lungs and escaped in the breath. As a result of this, the substances exhaling from the capillaries along with carbon dioxide and water vapour, gave an added impetus to the blood in the pulmonary capillaries, thus 'lessening congestion and relieving attendant distressing [spasmodic] symptoms'.[14]

If one believes that blood flow in the capillaries is increased when ether is exhaled, one might assume that it will be impeded if ether is inhaled. This was the argument adopted by Snow when, in 1847, he began to trace the manner in which ether acted as an anaesthetic. An observed reduction in the frequency of the pulse when ether was inhaled he attributed to the heart having to work harder to counteract the reduction in capillary flow resulting from the inhalation of the narcotic.[15]

Contemporary developments in physiology would have led Snow to consider that the changes he believed took place in the blood capillaries were associated with oxidation. Between 1837 and 1845 studies by Heinrich Gustave Magnus (1802-1870) on the concentration of oxygen, nitrogen and carbon dioxide in arterial and venous blood, led to the conclusion that combustion occurred in the body tissues and not solely in the lungs as suggested by Antoine Lavoisier (1743-1794). In 1842, Liebig wrote: 'According to views now developed, the globules of arterial blood, in their passage through the capillaries, yield oxygen to certain constituents of the body'. Liebig attributed the effects of alcohol on animal functions to its effect on changes of matter in certain parts of the body. Oxygen in the arterial blood which would normally combine with matter of the tissues, combined instead with the elements of alcohol.[16]

Initially, John Snow was of the opinion that most probably the narcotic action of chloroform and ether was similar to that described for alcohol by Liebig. Anaesthesia followed the appropriation of oxygen in the arterial blood resulting in the reduction of the normal oxidative processes in nervous and other tissues.[17,18] Some of the experiments he made with ether and chloroform appeared to support this. In vitro experiments showed a reduction in the combusion of phosphorus and the prevention of putrefaction in an atmosphere of narcotic vapours. Experiments on animals showed a reduction of body temperature under the influence of anaesthetics and a diminution of the volume of carbonic acid gas excreted from the lungs.[19] Snow saw these results as indicative of narcotic agents having an effect on the oxidative processes connected with animal functions related to sensation, motion and thought.

There were, however, some experimental results that suggested that Liebig's theory for alcohol could not be applied to ether and chloroform. Snow pointed out that his experiments demonstrated that ether and chloroform appeared to resist chemical combination and escaped unaltered in the breath. He found that an increase in the quantity of oxygen in the respired air did not prevent or reduce the action of the anaesthetic. Finally, the quantity of chloroform required to produce anaesthesia appeared to be insufficient to appropriate the amount of oxygen required to bring about such a profound change in animal function.[20]

Faced with evidence that chemical combination between oxygen and the anaesthetic vapour was unlikely, but remaining convinced that the oxidative process was in some way involved,

Snow resorted to abstract theory. He suggested that the anaesthetic agent acted as a suppressant to oxidation on the assumption that chemical combination between oxygen and body tissues might be prevented by the presence of a third agent. The idea required that the agent must have some kind of affinity with one of the two substances involved in the chemical combination. Snow observed that 'these substances [the anaesthetic agents] are known to possess a strong affinity for oxygen, being nearly all of them highly combustible.[21]

The theory was deeply flawed, and Snow was right to express his 'considerable diffidence' in offering a theory within the domain of chemistry. In addition to problems relating to the nature of chemical combination, there were two features that threw doubt on the concept. First, the suggestion that high combustibility is an indicator of the high oxygen affinity required to suppress oxidation was supported by ether but not by chloroform. Second, the argument relating to low concentration, which Snow used to refute appropriation of oxygen by chemical combination, applied equally as an argument against the narcotic agents acting as suppressants to oxidation.

Demise of the suppression of oxidation theory

In 1858, Benjamin Ward Richardson described the theory as Snow's greatest deduction,[22] helping to confirm the idea that anaesthetics influence the oxidative processes in the blood. It survived until the end of the nineteenth century, occurring in the literature as an alternative to a theory of direct influence on nervous tissue as suggested by Marshall Hall (1790-1857) in 1847.[23] It was cited by Thomas Lauder Brunton (1844-1916) in his influential *Textbook of Pharmacology*, first published in 1885, where he observed that chloroform appears to lessen the oxidising powers of the blood although not to a very great extent.[24] A decade later the German pharmacologist, Carl Binz (1832-1913) discussed a possible mechanism for the manner in which chloroform and ether suppressed oxidation but concluded that the amount of narcotic inhaled was not sufficient to change the normal constitution of the blood.[25] In 1899, Arthur Cushny (1866-1926), whose work included studies of the action of the anaesthetics, dismissed any suggestion that chloroform retarded processess related to oxyhaemoglobin.[26]

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ANAESTHESIA AND PHYSIOLOGY: THE FIRST TWENTY YEARS

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Any discussion of physiology during the first half of the nineteenth century must start with the discovery by Joseph Black (1728-1799) some fifty years earlier, that what he called fixed air, and we now call carbon dioxide, is contained in the exhaled air; and the demonstration by Antoine Lavoisier (1743-1794) in 1777, and in a series of papers during the next thirteen years, that during respiration oxygen is taken into the body, and an almost equal volume of carbon dioxide is breathed out. For the next half century the question was where the reaction between oxygen and carbon took place - in the lungs or in the periphery. An early proponent of the latter was CJB Williams (1805-1889), who in 1823 submitted a thesis in Latin, subsequently published in English, which set out the current position, and came out strongly in favour of the metabolic reaction being sited in the peripheral capillaries.[1] Williams studied with Laennec in Paris, pioneered the teaching and use of auscultation in the UK, was the first president of the Pathological Society of London, and was perhaps the first English specialist chest physician. He is of interest to historians of anaesthesia because Joseph Clover was his house physician at University College Hospital in 1846, and remained one of his protégés, so it may be expected that Clover had a thorough grounding in contemporary respiratory physiology and chest medicine.[2]

The second landmark must be the work of M F X Bichat (1771-1802). Those aspects which most concern anaesthetists are his division of the properties of life into two categories, organic and animal, and the distinction that he made between the death of the organism and the death of the tissues that make it up - in effect the first recognition of brain death.[3] This was taken up by Benjamin Brodie (1783-1862), and had a great influence on the conduct of resuscitative procedures. But also of importance was Bichat's philosophy. There is an immeasurable distance, he said, between the laws that govern the phenomena of the physical and the physiological sciences. 'The laws of natural philosophy are constant and invariable ... we know of no instance in which a stone gravitates towards the earth with more than its accustomed force, or where marble possesses more than its ordinary elasticity; on the contrary the vital properties are at every instant undergoing some change in degree or kind; they are scarcely ever the same.' Continuing along the same lines, with regard to inorganic phenomena: 'The formula once determined, nothing more is required than its judicious application to individual cases', whereas 'the vital functions, on the other hand, are subject to numberless varieties ... baffle all calculations, and would require as many formulae as the cases that occur. In their phenomena nothing can be foreseen, foretold, nor calculated ... '. It is a mistake to try to explain the phenomena of living bodies by the laws of inert bodies. Living bodies are in a state of flux, inert ones are still.[4]

Later, an anonymous commentator with a more subtle, formalising mind added the gloss that since, in Bichat's famous statement: 'Life is the totality of those functions that resist death', and the forces that *cause* death are those to which the Newtonian laws apply, then the phenomena of Life must be different in kind, so that those laws would not apply to them. Neither Bichat nor his commentator considered how any sort of integrated organism could function and survive if the responses of its parts to given stimuli were totally unpredictable.

The implication of Bichat's assertion is that the basic sciences, and quantification, have no part in physiology, where investigations, by and large, should only be observational, qualitative, and specific; attempts to extract generalisations are pointless. Although this view was challenged as early as 1809, by F Magendie (1783-1855), for whom the essence of a mature science was that a few principles explained a large number of facts, Bichat's restrictive influence persisted for many years. The French ideologues, who believed in trusting sense impressions only,[5] and their influence on Magendie's philosophy, has been discussed by Temkin.[6]

Magendie's contributions to physiology fall broadly into three groups. During the decade from 1809 he investigated the toxicology of strychnine, showing *en passant* that parenteral absorption takes place not only via the lymphatics, as was then thought, but also through the blood vessels, directly into the circulation. He investigated the loss of water vapour in the breath, and decided that the source of animal heat was not in the lungs. He studied the physiology of regurgitation and vomiting, the action of the oesophagus in swallowing, and the function of the epiglottis. In 1816 he published his *Precis*, a textbook of physiology in which he proclaimed his interest in applying the basic sciences, physics and chemistry, to the study of vital phenomena. In 1821 he produced his *Formulaire*, a pocket pharmacopoeia that was translated into many languages, and had great influence. In the same year he founded his journal of experimental physiology, of which he was the sole owner, editor, and referee. This provided him with a means of publishing his own researches, and those of his assistants and associates.[7]

The second stage of his work dates from 1821, when he began to concentrate his attention on the nervous system. His differentiation of the functions of the ventral and dorsal spinal nerves gave rise to the Bell-Magendie controversy, with Bell claiming priority, an argument which smoulders to this day. In 1824 he started to investigate the cerebro-spinal fluid, which, surprisingly, he is credited with having discovered, and in 1828 he described its circulation, and the foramen that bears his name. His last group of researches concerned the cardiovascular system, blood pressure and the origin of the heart sounds, resuming work started in 1834, but he gradually handed over to his assistant, Claude Bernard (1813-1878).

Also during the early 1820s, M J Flourens (1794-1867) began his study of the central nervous system. He investigated the functions of the cerebral hemispheres, the cerebellum, the brainstem and the cranial nerves, and the phenomenon of decerebrate rigidity. His famous demonstration of the effect of progressively slicing through the brain and brainstem disclosed the existence of the respiratory centre in the medulla, the 'vital node'. However the technique of taking slices across all structures made it impossible to investigate the functions of the various individual areas.[8]

Claude Bernard's work was concerned initially with the function of the digestive enzymes, notably the pancreatic secretions, and with glucose, glycogen, and carbohydrate metabolism. He discovered the vasomotor effects of the sympathetic nervous system and the site of action of curare, and went on to enunciate the doctrine of the constancy of the *milieu internale*, the internal environment. In contrast to Bichat, both he and Magendie have been described as physiological determinists, holding the belief that, all other things being equal, a given stimulus will always produce the same response; hence physiological experimentation *is* reproducible and quantifiable, and its results *can* be generalised. The move in this direction

received a strong impulse from the development of apparatus that allowed physiological parameters first to be measured, and then to be recorded.

Cardiovascular research.

Stephen Hales (1677-1761) had measured the arterial blood pressure of a horse in 1711, but had need a glass tube nine foot long. In 1828 Jean-Louis Poiseuille (1799-1869) in the thesis for his doctorate, described a more practical apparatus for measuring the blood pressure in animal experiments. It consisted of a short mercury-filled U-tube, which was connected to a main artery. Poiseuille worked with Magendie, but gradually became more interested in the physics of fluid flow through small-diameter tubes. He formulated the law relating flow velocity to area and pressure gradient, in 1840. Poiseuille also invented a 'pulse measurer'. This was a fluid-filled box that was placed round an exposed artery - hence only suitable for manimal experiments. A vertical tube rose from the box, and the column of fluid in this tube oscillated with each pulse. This innovation was followed by Jules Herisson's description in 1834 of the so-called tubular sphygmometer. This was a glass tube with an expanded funnel-shaped end covered by a tightly-stretched membrane (Fig 1). The whole apparatus was filled with mercury, and when the membrane was placed on a pulsating artery the meniscus fluctuated with each beat. About 1850 a similar device was used by Ugham and Kemp to complete an electric circuit and cause a bell to ring at each pulse - the sphygmophone, a potential monitoring device. It is not generally known that John Snow's friend, Benjamin Ward Richardson, in 1879 was the first to use the newly-invented microphone to render the pulse beat audible.[9]

Figure 1. Herisson's sphygmometer

During the 1840s the lead in physiological methodology passed from France to Germany.[10] The outstanding advance was in the development of apparatus which allowed the graphic recording of physiological phenomena. This had the enormous advantage that previously fleeting subjective impressions could be objectivised, analysed in detail at leisure, and shown to people who had not been present when the original observations were made. This interchange of information was facilitated by the explosive developments in communication -

railways, steam ships, postal services, journals, and great international exhibitions and conferences.

Carl Ludwig (1816-1895) in 1847, by adding a float and a stylus to Poiseuille's tube, invented the apparatus to which Volkman gave the name kymograph (wave writer), which was able to make recordings of the pulse wave. (Fig 2). These confirmed that the pulse could be irregular, and quickly demonstrated that the shape of the wave was variable also; arguments about the cause and significance of the dicrotic notch continued for some years. The interposition of sodium carbonate solution between the blood and the mercury delayed clotting. It was soon realised that the inertia of the mercury column damped the shape of the wave, so to get a more accurate representation Ludwig's pupil, Adolf Fick, designed an apparatus using mechanical linkages. For application to man, Karl Vierordt (1818-1884) invented, in 1853, a device consisting of a system of levers mounted on a gantry. By adding weights he attempted to estimate the blood pressure. The disadvantages of this cumbersome and heavily damped original were overcome by successive modifications. The more compact apparatus of E J Marey (1830-1904) made it possible to produce an accurate tracing of the pulse wave (Fig 3). Further refinements by Benjamin Ward Richardson and others, culminated in the Dudgen sphygmograph which, like the kymograph, some will remember being still in use in the physiology laboratory until the second half of this century.[11] When medical students are told nowadays that the first thing one learned in practical physiology was how to smoke a drum, they wonder what sort of depravity this signifies (Fig 4).

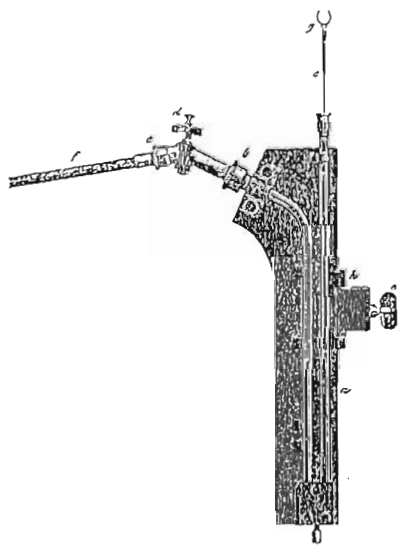

Figure 2. Ludwig's recording manometer. The long rod of marker *e* has a bulb floating on the mercury

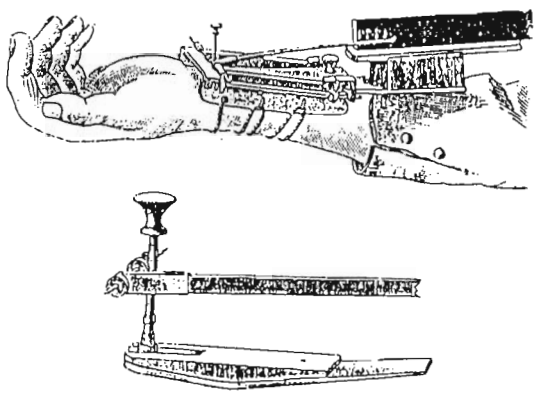

Figure 3. Marey's sphygmograph. Enlargement shows the lever and spring which presses on the artery

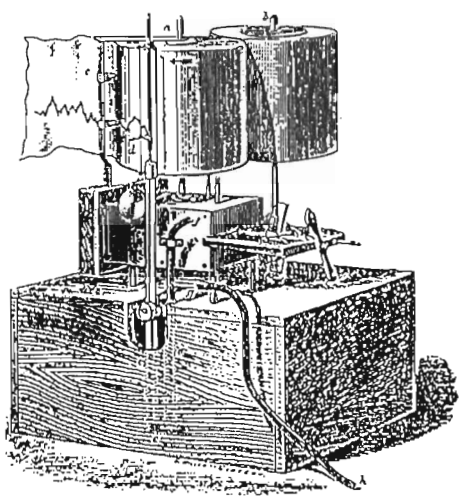

Figure 4. Mercurial kymograph using smoked drum

Attempts to measure the velocity of blood flow started in 1850, when A W Volkmann (1800-1877) constructed his haemodromometer. This worked by timing the displacement of saline from a known length of glass tubing (Fig 5). Other devices were invented by Vierordt, and by J B A Chauveau (1827-1917), on the principle of the stream of blood impinging on a flat paddle attached to a pointer that moved across a scale. The best known, still illustrated in physiology textbooks until fairly recently, was Ludwig's Stromuhr (current clock) of 1867 (Fig 6).

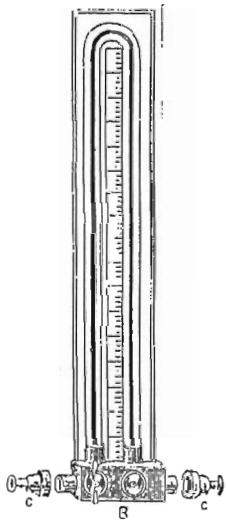

Figure 5. Volkmann's hacmodromometer

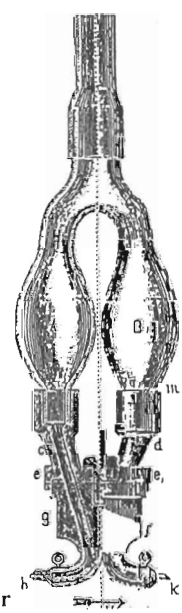

Figure 6. Ludwig's Stromuhr

Chauveau was one of the pioneers of French cardiovascular physiology not sufficiently known in this country. He was a leading veterinary surgeon who conducted the most astonishing research. In 1861, in association with E J Marey, using a double tube with two rubber cuffs, he catheterised the internal jugular vein of a horse, and obtained intra-cardiac pressure tracings from the right atrium and ventricle (Fig 7). He used a similar device, with a tambour or listening device at the outer end, to determine the sequence and origins of the heart sounds.

Nervous control and electrical activity of the heart

In 1845 the Weber brothers (E F H, 1806-1871, and E H, 1795-1878), discovered that stimulation of the pneumogastric nerve or vagus, in the neck, caused the heart to slow or stop, depending on the strength of the stimulus. Section of the nerve was followed by acceleration of the heart rate. Regarding establishment of the sympathetic control of the peripheral blood vessels, there is some evidence that the British physiologists; A V Waller and William Sharpey have a claim to share the credit with Claude Bernard.

A V Waller's son, A D Waller (1856-1922) was the first to demonstrate in man the electrical activity that accompanies the propagation of the impulse - the electrocardiogram. However, it was shown as early as 1856, by R A von Kölliker (1817-1905) and H Müller (1820-1864) using a sensitive galvanometer, that a wave of negativity passes from apex to base of the ventricle of an isolated beating heart. Waller did not *discover* the electrical activity of the heart. This had been demonstrated years earlier in animals, using the capillary electrometer, by J S Burdon-Sanderson (1828-1905) and F J M Page (1848-1907).

Respiratory Physiology

The earlier work on lung volumes was systematised in the early 1840s by Julius Jeffreys (1801-1877),[12] and put on a clinical basis by John Hutchinson (1811-1861), with the development of his spirometer (Fig 8). By 1846 a range of normal values had been established, correlated with height, and it was possible to demonstrate the presence of pulmonary pathology by reduction from normal volumes.

Academic physiology in the United Kingdom

In the United Kingdom academic physiology was dominated by three restrictive ideologies. The first, significant until the end of the 1830s, was John Hunter's variety of vitalism, the belief that a 'principle of life' was present in every fragment of a living being, especially including the blood. The second was the increasingly influential anti-vivisection movement, which was to become a continuing impediment to research. The third was the 'natural theology' movement, which held the belief that the investigation of nature would provide a means of proving the existence of God, and a demonstration of the perfection of His works. Active in this movement, which was associated with the production of the series of Bridgewater Treatises, were Sir Charles Bell, William Prout, and Peter Mark Roget.[13] One effect of this ideology was an emphasis on structure-function relationships, which resulted in English physiology being closely tied to anatomy and physiology rather than to the basic sciences, physics and the rapidly developing organic chemistry.

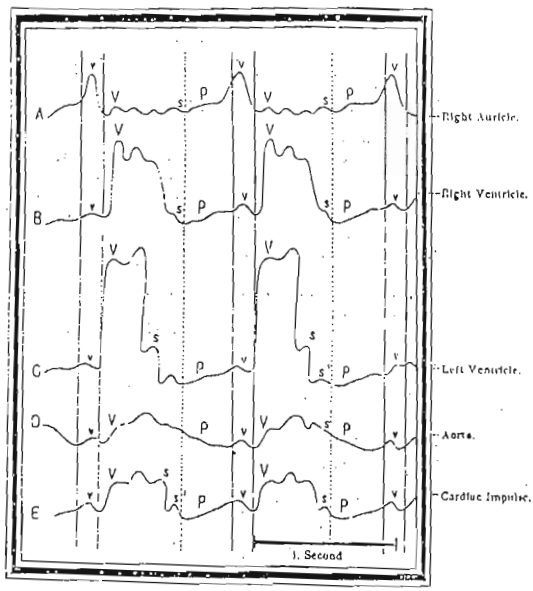

Figure 7. Curves from the heart of a horse

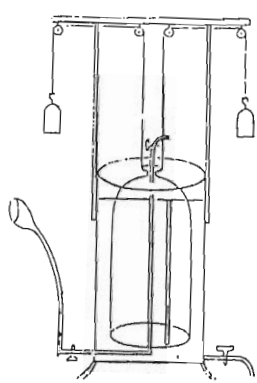

Figure 8. Scheme of Hutchinson's spirometer

Although there were a number of individual, independent researchers, including those mentioned above together with Benjamin Brodie, John Davy, and Marshall Hall, the usual pattern was that research was the prelude to the development of a successful practice. The first and only full-time academic physiologist in the United Kingdom, from his appointment in 1836 until about 1870, was William Sharpey (1802-1880), but even his chair, at University College, London, was a combined one in anatomy and physiology. Not until 1859 was a separate room fitted up in his department for experimental physiology, which really meant microscopy and histology. Only in 1870, when Michael Foster (1836-1907) was appointed to Cambridge, and Burdon Sanderson to the Chair of Practical Physiology and Histology at University College, London, did physiology become an independent discipline.[14]

In 1862, addressing the annual meeting of the British Medical Association, Sharpey reviewed the advances of the previous twenty five years, and the existing state of the art.[15] He attributed the accelerated pace of advancement to the establishment of schools of practical physiology and chemistry, especially in Germany and Holland. In London physiology had been a subject in the Arts degree for the past twenty years, but was now 'carried to a much higher pitch' in the recently instituted Science degree. The older universities had followed the same line. Sharpey spent some time defending researchers against the powerful attacks of the antivisectionists, which are now regarded by some historians as one of the main causes of the failure of English physiology to keep up with progress on the Continent. The recent advances he reviewed included usage of the microscope, the ophthalmoscope, and the indirect laryngoscope. Great advances had been made in the study of the structure of the tissues. The development of the much improved compound microscope had led to the cell theory promulgated by Schwann. But one of the most significant steps had been the general recognition of the importance of 'exact numerical determination', by which he meant measurement. Both the pressure and flow rate of blood had been measured experimentally, and it was known that the time taken for a complete circulation was much shorter than was previously believed. The entire quantity of blood in the body was now known. The force of muscle contraction in various conditions had been measured, and 'perhaps the greatest triumph of precise instrumental determination, the velocity with which a stimulus is conveyed along a nerve. Measurements could now be recorded on a rotating drum driven by clockwork.

Much had been learned about the chemical constitution of food, nutrition, and the operation of the salivary, gastric, and pancreatic fluids in digestion. Chemists had produced a balance sheet of foods and oxygen taken in, and final products given out. He remembered the time when it was thought that potash and soda passed practically as equivalent, but there was reason to think that they perform very different services in the living economy. There had been very active research into the physiology of the nervous system, and he singled out the work of Dr Augustus Waller. The electric induction coil had proved a great advance on the means previously used to stimulate the nerves. It had been demonstrated that glandular secretions, and the state of the blood vessels, were affected by artificial stimulation of the nerves going to them.

He concluded with a pointer to the future: 'We can perceive nothing in the ovum of man to distinguish it from that of a quadruped, though their final destination is so different. We are constrained, therefore, to admit some pre-existent condition - to us inscrutable - which

determines the specific direction in which the forces acting in development, although probably supplied from without, must operate within the organism'. He himself held with a teleological explanation for this, and all the other phenomena of physiology, and went on both to suggest a link with Darwinism, and to plead that 'narrow views of the scheme of Providence, worthy of a darker age', should not 'join in blindly denouncing the genial effort of one of the foremost men of science in our time ...'. Even if the various adaptations of living beings should ever be shown to have been brought about by the operation of great natural causes, these would have been originally ordained by the Author of the Universe, and the discovery 'could but tend to enlighten and exalt our conceptions of creative wisdom'. With this plea for no ideological restraints on physiological investigations, coupled with obeisance to the still powerful natural theologists, he brought his address to a close.

It is usually said that Sharpey himself made no fundamental discoveries, and such research as he did was designed to confirm findings published from elsewhere, usually from the continent of Europe, which he intended to include in his lectures. But Geison[16] disputes this, claiming that Sharpey's diffidence led him to allow priority to others. This may be particularly the case with respect to the vasomotor nerves. But Sharpey's greatest achievement was to inspire his juniors, from among whom arose the leaders of the next generation of British physiologists.

Applications to anaesthesia

Now we have to ask to what extent these advances in physiology were reflected in the practice of anaesthesia. The influence of late eighteenth and early nineteenth century physiology on the practice of resuscitation has been discussed in previous publications, and this was perhaps the earliest clinical field in which such influence of a basic science can be detected.[17,18] John Snow's paper on resuscitation of the newborn is an example.[19] With anaesthesia the situation is rather different. We know from his *Case Books* that John Snow from time to time was asked to give an opinion on a patient's fitness for an anaesthetic.[20] We know that as part of his clinical examination he counted the pulse, auscultated the heart and lungs, and tested the urine; but we have no idea what criteria he used to decide whether to anaesthetise or not. We have seen that by the mid-1850s the technology existed that would have enabled him to measure the vital capacity, do a blood count by the method introduced by Vierordt in 1853, roughly estimate the blood pressure, and, with assistance, record the pulse wave during an anaesthetic; and we can be sure that he did none of these things. Even as late as the mid-1950s, if a spirometer was used at all, it was to estimate the basal metabolic rate, not to measure the vital capacity. Bynum has written about the development of applied physiology and the growth of laboratory medicine, but these facilities were still struggling for existence at the beginning of the twentieth century.[21]

The place to explore the influence of physiology on anaesthesia is firstly in the writings of the pioneer researchers. Flourens, during February and March 1847, using ether, and then ethyl chloride and chloroform, stimulated the exposed central nervous system of animals at progressively deeper levels of anaesthesia, and established that these agents affected successively the cerebrum, the cerebellum, the spinal cord, and finally the vital centres in the medulla. Failure of the medulla to respond to a direct stimulus was invariably followed by death. He also drew a similarity between etherization and asphyxia.[22]

John Snow's researches, whether deliberately or not, to some extent mirrored those of Flourens, and contradicted some of his conclusions. Among Snow's earliest contributions to the science of anaesthesia was his assertion that like every other drug, the dose administered must be known and regulated. In furtherance of this end he studied the concentration of vapour taken up by a given volume of air at various temperatures, in effect the saturated vapour pressure, and he constructed and published a table that would allow the administrator to have control of what the patient was receiving, by varying the temperature of the vaporizing chamber. Then he went on to study the effect on animals of different inhaled concentrations of anaesthetic vapour, and from this he attempted to calculate the blood level of the agents. Finally, taking advantage of the quantitative methods of organic analysis introduced by J von Liebig (1803-1873) in 1849, he estimated directly the actual blood level, collaborating in one instance with medical jurisprudent Alfred Swaine Taylor.[23] As far as I can ascertain, Snow appears to have been one of the first in the United Kingdom to even think about the blood level of drugs; if so, this is surely a most remarkable first. Also, within four months of the introduction of chloroform, he enunciated the general rule that the potency of an inhalational agent is inversely related to its solubility in the blood.

All this could be regarded as pharmacology rather than physiology, but in physiology too, as applied to anaesthesia, Snow was in the forefront. He accepted the periphery as the site of the chemistry of respiration, something still not universally agreed upon. As late as 1849 it was asserted that the carbon particles found at postmortem in the lungs of the elderly were not always from the inspiration of impure air, but appeared frequently to be derived from insufficient pulmonary combustion of carbon.[24] In locating the oxidative reaction in the peripheral capillaries, not in the lungs, nor in the tissues, Snow may have been influenced by a paper by J R Mayer (1814-1878), which claimed that very little oxidation takes place outside the blood vessels.[25] Snow's early research had demonstrated to him that adding twenty percent ether vapour to inhaled air would, purely by physical displacement, reduce its oxygen content. This opened the possibility that anaesthesia was just a mild form of asphyxiation, which he disproved by augmenting the volume of oxygen breathed during anaesthesia. Since this had no effect on the course of the anaesthetic, he concluded correctly that anaesthesia is different from asphyxia, and erroneously that therefore oxygen had no part to play in the conduct of an anaesthetic. This was in surprising contrast to Robinson,[26] and also to Scott,[27] who pointed out that at 68° F an inhaled mixture would contain 57% ether and only 9% oxygen. Finally, by careful chemical analysis, Snow showed that during anaesthesia oxygen usage and carbon dioxide output are both reduced, and he concluded that anaesthetics act by, to put it in modern form, reducing the rate of tissue respiration.

The application of all this to the conduct of an anaesthetic can be seen in Snow's early review of reported deaths under anaesthesia.[28] While not all the points he makes would be regarded as valid today, he clearly sets out the importance of a graduated and smooth induction, and the principles that underlie its achievement, based on what was known of cardiovascular and respiratory physiology, and the pharmacology of the anaesthetic agents. In a later publication, almost as a throwaway remark, he showed a profound appreciation of the importance of the rate of circulation and respiration in determining the return of consciousness, commenting also that it is the phenomenon of tissue redistribution, not total exhalation, that is responsible for recovery.[29] Mention should also be made of his experiments with a closed technique using carbon dioxide absorption. But on oxygen and anaethetic uptake his ideas were simplistic, if not mystical.[30]

From his various writings, and his researches, we can say that Snow had no difficulty in regarding the body as a chemical machine. He was very much in the school of Magendie and Bernard, rather than that of Bichat. In his Oration to the Medical Society of London in 1853, after discussing the various types of chemical reaction, or as he called them, molecular actions or changes, he concluded that: 'there is no distinct line of demarcation between vital processes and those that are not vital'.[31] Nothing is known about any religious beliefs during Snow's adult life which might have influenced his attitude to research into human physiology, nor about his views on Darwinism, which subject was already much 'in the air', although *The Origin of Species* was not published until the year after his death.

Joseph Lister (1827-1912), in his article on general anaesthesia in Holmes's *A System of Surgery* of 1862, seems to have been the first to give a physiological reason for its benefits, over and above that of simple pain relief. Drawing on the work of Flourens, he pointed out that chloroform acts on the nervous system, suspending its functions in a certain order - the brain, the spinal cord, including the reflex actions of the cerebro-spinal axis - with the remarkable exception that the parts concerned in the respiratory movements remain active; and the same is the case with the sympathetic ganglia of the heart. In other words, when the administration of chloroform is carried to a certain point, the nervous system is deprived of such powers as would cause pain to the patient or inconvenience to the surgeon, but retains intact the faculties essential to life. 'There are, however, yet other advantages derived from the inactivity of the cerebro-spinal centre. It seems now clearly established that the cessation of the contractions of the heart in the shock of injury depends upon an action of the brain and cord upon the cardiac ganglia through the medium of the vagus and sympathetic nerves; and chloroform, rendering this action impossible, protects the heart from the indirect effect of external violence. In this way it has diminished the risk of death upon the operating table, and also has overthrown the old rule of deferring amputation in cases of injury until the patient has recovered from the state of collapse; thus shortening the period of mischief to the system from the presence of the mangled limb, and in extreme cases sometimes saving life where it would be hopeless to wait for returning consciousness.'[32] So here we see the first stage, or recognition, of what was to develop into Crile's idea of anoci-association.

Lister, although trained at University College Hospital, London, partly by Clover, had as Syme's son-in-law, fallen deeply under the Scottish influence. He believed that: 'the very prevalent opinion that the pulse is the most important symptom in the administration of chloroform is certainly a most serious mistake. As a general rule, the safety of the patient will be promoted by disregarding it altogether, so that the attention may be devoted exclusively to the breathing'. He went on to assert that 'preliminary examination of the chest, often considered indispensible, is quite unnecessary ... and that the appointment of a special chloroform-giver to a hospital is not only entirely unnecessary, but has the great disadvantage of investing the administration of chloroform with an air of needless mystery ... '. His description of the actual technique of anaesthetising with chloroform occupied some seven lines, and he concluded with these reassuring words: 'These simple instructions may be acted on without difficulty by an intelligent medical man. The notion that extensive experience is required for the administration of chloroform is quite erroneous ...' Thus he dismissed John Snow and all his works; as regards anaesthesia, Lister may be described as a minimalist. In fairness, it must be mentioned that he appears to have been the first to carry out any research into the anatomy and physiology of the mechanism of stertorous breathing and respiratory

obstruction during anaesthesia, recognition of which is surprisingly absent from earlier texts.[33]

John Snow asserted, and taught, that death under chloroform was due to the inhalation of a high concentration, and by animal experiments showed that the safe upper limit was 5%. Joseph Clover (1825-1882), in 1862, translated an earlier attempt by Snow into a practical inhaler. He devised a very large reservoir bag, which he filled with a 4.5% vapour, so eliminating the risk of overdose. However chloroform deaths continued to occur in the hands of others, and at the same time there was strong disagreement between the English and Scottish schools about both the safe way to administer chloroform, and to monitor the patient. So in 1862 the Royal Medical and Chirurgical Society set up its Chloroform Committee to investigate the effects, use, and safety of ether and chloroform. It is in the work of this Committee that we can see the early, if not the first, application of the recent advances in physiological techniques.

The Chloroform Committee

The researches consisted of the administration of ether or chloroform to a considerable number of animals, mainly dogs, including some where the vagus nerves had been cut, and observation of the effect on the heart rate, the rate of respiration, and in some instances on the blood pressure. The research was conducted in the physiology laboratories of University College, in the Department of Professor Sharpey. Naturally there was no practising anaesthetist on the Committee, but Clover was its principal adviser. He is thought to have designed and conducted most of the experiments, and to have strongly influenced many of the Committee's recommendations.

The report states that the haemodynamometer was used to mark the extent of the failure of the force of the heart's action. The results were remarkably uniform, and the conclusions to which they point deserve attentive consideration. The instrument was set at zero, then connected to the femoral artery. The mercury at once rose, indicating the pressure of blood in the vessel. Two fluctuations were observed, a greater corresponding with respiration, and a lesser, timing with the arterial pulsation.

Since no tracings such as Fig 9 are reproduced in the report, but only tables of observations, it may be assumed that the earlier version of the manometer was used rather than a recording kymograph. From what has been noted about the University College Department it seems that the work done for the Chloroform Committee was innovatory. A certain naivety in the tone of that part of the Report tends to confirm this impression.[34]

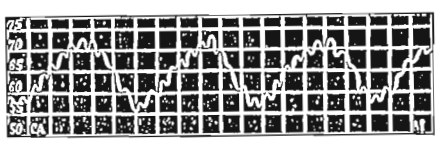

Figure 9. Mercurial kymograph tracing from carotid of a dog

The Committee's conclusions are well-known, and have been thoroughly analysed by Dr Duncum.[35] With chloroform it was observed that the pulse became imperceptible some time before the heart ceased to beat, and before respiration ceased. This fall of blood pressure, measured with the haemodynamometer, was interpreted as due entirely to direct depression of the heart muscle, no mention being made about vasodilator effects. With ether the blood pressure was much better sustained, right up to the cessation of respiration. Hence the conclusion that chloroform kills by depressing the action of the heart and inducing syncope, whereas if death is produced by ether, it 'is almost invariably due to the failure of the respiratory movement, and the heart is generally found to continue its pulsations for some time after the respiration has ceased'. Logic would dictate that with chloroform one should monitor the pulse, and with ether the respiration, but the Scottish school was not convinced, and Clover later took issue on this and on Lister's use of tongue forceps. The Committee recommended the use of a chloroform-ether, or alcohol-chloroform-ether mixture, the so-called A C E mixture of George Harley (1829-1896), who had been Sharpey's assistant at University College.[36]

Conclusion

Although very great advances had been made in experimental physiology and the techniques of investigation during the twenty years that followed the introduction of inhalational anaesthesia - in fact one could say that modern physiology had been born during this period - virtually all the developments had taken place on the Continent. As regards the application of physiology to the practice of anaesthesia in the United Kingdom during the first twenty years, outside the experimental work here described it is difficult to find any. In fact Gerald Geison, Michael Foster's biographer, could not find any application of physiology in the whole of clinical medicine before about 1880. This is probably a little extreme. Nevertheless the first anaesthetics textbooks showing the application of 'laboratory' physiology to anaesthesia, of which Beecher's was the harbinger,[37] by and large relate to the introduction of pharmacologically specific drugs such as the hypotensives and the neuromuscular blocking agents, and the need to understand the underlying physiology. Thus it was not until the second half of the 1940s, and the somewhat later involvement of anaesthetists in intensive care medicine, that applied physiology became an essential component of anaesthesia.

Further reading

The state of physiology in England during the period under discussion is reviewed by Gerald L Geison in his *Michael Foster and the Cambridge School of Physiology*, Princeton University Press, 1978. According to the reminiscences of his students, Sharpey did not possess a kymograph, and to demonstrate its function used to rotate his top hat with one hand while tracing a wave form with a finger of the other. A more intimate picture of Sharpey, and his reaction to the first ether anaesthetic at University College Hospital, will be found in L S Jacyna's *A Tale of Three Cities: The Correspondence of William Sharpey and Allen Thomson*, London, Wellcome Institute for the History of Medicine, (*Medical History*, Supplement No.9), 1989. Stanley Joel Reiser's *Medicine and the Reign of Technology*, Cambridge University Press, 1978, provides a wide-ranging survey of the introduction of scientific methods into medicine. Kenneth Keele's FitzPatrick Lectures of 1960-61, published as *The Evolution of Clinical Methods in Medicine*, London, Pitman Medical, are equally excellent. W F Bynum's *Science and the Practice of Medicine in the Nineteenth Century*, Cambridge

University Press, 1994, covers the subject more broadly. The history of the discovery of the vasomotor nerves, and a critical evaluation of Bernard's part, is contained in the essay by Hoff H H and Guillermin R, on Claude Bernard and the vasomotor system, in: Grande F and Visscher M B, eds. *Claude Bernard and Experimental Medicine.* Cambridge, Mass: Schenkman Publishing Company, 1967. References for virtually all the first descriptions of the physiological apparatuses mentioned above will be found in Garrison and Morton, *A Medical Bibliography.*

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THE DISSEMINATION OF KNOWLEDGE

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In the first issue of the *Lancet* for the year 1847[1], there was a long leading article dealing with the current Medical Registration Bill, then before parliament. This article was almost certainly written by the journal's aggressive and radical editor, Thomas Wakley, who by then was Member of Parliament for Finsbury as well as serving as the reforming Coroner for Middlesex. There was, however, another leading article, whose brevity belied its importance, on a new and harmless method of inducing insensibility during surgical operations. The anonymous writer of that piece wrote:

> 'On another page we insert an important communication forwarded to us by Dr Boott of Gower Street, describing the important discovery of an apparently harmless means of producing insensibility during the performance of surgical operations. The means of performing operations without pain has, in all ages, occupied the attention of the profession. The realization of such an object, by a means so simple as the inhalation of the vapour of sulphuric ether, cannot but redound to the great merit of the discoverer, Dr Morton of Boston, America, and to the honour of the profession to which he belongs. It is almost impossible to discredit the statements contained in the communication referred to, from which it will be seen that a great number of operations, from the extraction of teeth to the gravest operations in surgery, have been painlessly performed ..... We hope that we shall hear no more of mesmerism[2].'

Thus did the *Lancet* welcome the news of Morton's discovery, as well as taking the opportunity of continuing its assault on mesmerism, which had been claimed to have some success in enabling surgeons to operate without pain, a suggestion to which the *Lancet* had been vigorously opposed.

For those concerned with the dissemination of knowledge of ether anaesthesia, the leading article prompts two questions. The first is the identity of Dr Boott, not a name to conjure with in medical circles at that time, and why he was involved in the affair. The second is why the *Lancet* was chosen to publish the first accounts of the use of ether anaesthesia in Britain.

Why Dr Boott?

Dr Boott's letter to the editor explained that he was sending a private letter from Dr Bigelow (Dr Jacob Bigelow 1787 - 1879): 'one of the first physicians of Boston, a Professor of the Medical School of Harvard College, and a man of great accomplishment'.[3] Bigelow's letter began 'My dear Boott', an address in those days familiar enough to suggest a more than formal relationship between them. Bigelow related that, after Dr Warren's operations in Boston with ether administered by Morton, he had taken his own daughter to Dr Morton to have a tooth extracted. At the end of the procedure she stated that she had felt no pain 'nor had the slightest knowledge of the extraction'. But it was the paper enclosed by Bigelow that was to be more important. His son, Henry Jacob Bigelow (1818-1890),[4] was one of the foremost surgeons at the Massachussetts General Hospital and he had witnessed the famous operations in what became known as the Ether Dome on 16 October. It was H J Bigelow who

first published in a reputable medical journal an account of the first operations as well as his descriptions of the use of ether in a series of operations of his own. These appear to have been carried out within two weeks of the original operations of Dr Warren. By 3 November 1846, H J Bigelow was ready to read an abstract of his work to the American Academy of Arts and Sciences, an important learned society in Boston, of which his father was to become President the next year. A full paper was then read to the Boston Society of Medical Improvement and this was then published in the *Boston Medical and Surgical Journal* (later the *New England Journal of Medicine*) on 18 November 1846.[5] It was a copy of this paper that Jacob Bigelow, father of the author, sent to Francis Boott. It was published in full in the *Lancet* in that first issue for 1847.[6]

There were, however, two further letters from Boott to the Editor that were published in that issue of the *Lancet*.[7] The first, dated Gower Street Dec 21, 1846, related how on Saturday 19th 'a firmly fixed molar tooth was extracted in my study from Miss Lonsdale, by Mr Robinson, in the presence of my wife, two of my daughters and myself, without the least sense of pain'. This was clearly the first recorded account of the use of ether in England for producing insensibility. Boott's second letter was of greater significance for it recorded Robert Liston's performance of two operations on patients inhaling ether, following which he is reputed to have made the immortal comment 'This is no Yankee dodge'. Boott, who had sent the reports of the Boston experiments to Liston, included Liston's acknowledgement of this in his letter, dated Clifford Street Dec 21, 1846. Unlike Bigelow, he addressed the letter with the customary formal 'My dear Sir'. He wrote:

> 'I tried the ether inhalation today in a case of amputation of the thigh, and in another requiring evulsion of both sides of the great toenail, one of the most painful operations in surgery, and with the most perfect and satisfactory results. It is a very great matter to be able thus to destroy sensibility to such an extent and without apparently, any bad result. It is a fine thing for operating surgeons, and I thank you most sincerely for the early information that you were so kind as to give me of it.'[8]

At the end of the letter Boott had appended a note stating that he hoped Mr Liston would report these cases more fully.

These observations illustrate how rapidly knowledge of the use of ether was disseminated, at least in the English-speaking world. If the Bigelows, father and son, had played an important part in that dissemination from the United States, Boott certainly deserves recognition as having sent the information from the Bigelows to both the editor of the *Lancet* and to Robert Liston, one of the foremost surgeons in London.

Remarkably, Dr Francis Boott[9] was not a practicing physician nor in any sense an active member of the profession at that time. He was in fact known, and is remembered today, far more for his botanical work than for anything he did for medicine. Significantly, he was an American and a New Englander. He was born in Boston in 1792 and received his education at Harvard, following which he moved to England where he pursued his interests as scholar, botanist and writer. Throughout his life he led a transatlantic existence, travelling between America and Britain and preserving his friendships on both sides of the ocean. His particular friendship with Jacob Bigelow was due to their mutual interest in botany. Bigelow was, in addition to his distinction as a physician, a botanist who had published the standard works on

the flora of New England and Boott, as a young man, had explored the mountains of New Hampshire with him when he was preparing the second edition of his *Flora Bostoniensis*. It is therefore not surprising that when Bigelow sent his epoch-making material on the new Boston discovery, he sent it not to a member of the London establishment but to his old friend and compatriot Francis Boott.

Boott was medically qualified. In 1820, already married, he decided to take a medical degree and he graduated MD in Edinburgh in 1824. He practiced medicine in London for seven years but then, having come into an inheritance, gave up practice and concentrated on his major interest, botany. He was a leading light at the Linnean Society, serving both as secretary and treasurer. He is remembered today particularly for his *magnum opus*, in four parts, on the genus *Carex*, a group of water-loving grasses or sedges. He died of pneumonia at his Gower Street home on Christmas Day 1863. A contemporary of John Snow, he lived to see anaesthesia established world-wide, America's first major contribution to the practice of medicine.

Why the *Lancet*?

It is, in retrospect, easy to understand why Boott sent the ether papers to the *Lancet* for publication. The *Lancet* in 1846-47 was approaching its silver jubilee. It had led a chequered but successful existence since its foundation in 1823. Under the dynamic leadership of its swashbuckling founder and editor, it was always a pioneering and radical journal, playing a major role in the events that led to the passage of the medical bill of 1858 which established the General Medical Council. It is uncertain whether Boott knew Wakley, but in 1846 he would certainly have known of him and the reputation of his journal for pioneering new and radical causes.

The origins of the *Lancet*, like anaesthesia, are to be found in America, and particularly in Philadelphia.[10] It was the English radical, William Cobbett, who had encouraged the first editor of the *Lancet* in a career of radical medical journalism. Cobbett was one of the first campaigning medical journalists. He went to Philadelphia in 1794 and soon became involved in the controversy surrounding the treatment of yellow fever, discouragingly frequent in epidemics that ravaged the city during those years. Cobbett, writing first as Peter Porcupine in his *Porcupine's Gazette*, vigorously attacked Benjamin Rush, then the best known of America's physicians, for his depleting regime in the treatment of yellow fever. He castigated Rush as a 'poisonous transatlantic quack' and as a 'Samson of medicine who slaughtered thousands of citizens'. Rush took legal action, forcing Cobbett into bankruptcy and to a return to England in 1800. It is significant that by the time the Bostonians were establishing the importance of ether nearly half a century later, Rush, once regarded as the American Hippocrates, had been completely discredited.

Cobbett did not become involved with Thomas Wakley until more than twenty years later.[11] In 1820, when the old mad king, George III (the last King of America), died, a group of desperados intent on murdering the Prime Minister and his entire cabinet were apprehended at their haunt in Cato Street. The five ringleaders of what came to be known as the Cato Street conspiracy were hanged on May Day 1820 before a huge crowd outside Newgate jail. The bodies were then cut down and the heads removed, to the mounting anger of the crowd. The decapitator was in fact Tom Parker, an anatomy assistant at St Thomas's but rumour put

it about that he had been a surgeon living in Argyll Street. The only surgeon living there at that time was Wakley, 25 years old, newly married and starting in practice as a surgeon. In August 1820, a gang of men supposedly sympathetic to the Cato Street conspirators broke into Wakley's house, assaulted him and burnt his house to the ground. This was a disaster to the young Wakley and it was now that William Cobbett, himself a possible target for the Cato Street gang's friends, since he was considered in later years to have abandoned his crusading zeal, persuaded Wakley that there was as much need in England for medical reform as for its political counterpart. The name, the *Lancet,* was chosen as reflecting its purpose of incising the abscess on the medical body politic.

The first issue of the *Lancet,* published on Sunday 5 October 1823, set out its objectives. For the first time the lectures of the distinguished professors and consultants at the London medical schools were to be published. Medical and surgical intelligence, the current political scene, drama and chess also formed part of the new journal's interests. Wakley's radical and reforming zeal, stimulated by Cobbett who could often be found at the *Lancet,* at once brought him into conflict with the medical establishment of the time, for he attacked the power of the Royal Colleges of Physicians and Surgeons, as well as that of the Worshipful Society of Apothecaries whom he castigated as the Hags of Rhubarb Hall. Other medical journals, established in London at that time, attacked him as an upstart who had broken in on the peace and quiet of the profession. There were to be nine law suits during the first six years but the overall results were favourable to Wakley and unlike Cobbett's unfortunate experience in Philadelphia, the circulation of the *Lancet* rose progressively and it became increasingly successful. By 1846, when Francis Boott sent the Boston material on ether to the journal, many of Wakley's competitors during his early years as editor had gone out of business and the *Lancet* was the only journal in the country with both a national and an increasingly international reputation. It was for this reason, and for its reputation for fearless reporting, that Boott entrusted the American papers to the *Lancet.*

Another report from America

It may be asked, where was the *British Medical Journal*? At that time it had not yet been founded since it did not appear until ten years later. Its main progenitor was the *Provincial Medical and Surgical Journal*, whose parent Society, the Provincial Medical and Surgical Society, had been founded in Worcester in 1832. The Society had an annual meeting which in 1846 took place in Norwich. An honoured guest was Dr John Ware (1795-1864), a distinguished Bostonian who was Hersey Professor of the Theory and Practice of Physic at the Harvard Medical School.[12] After his return to New England in the autumn, he clearly heard of the discovery that was the only subject of conversation among the medical profesion in America at that time. He at once wrote to Dr Forbes, of the Provincial Association, his letter being dated November 29th. The letter was published in the *Provincial Medical and Surgical Journal* in its first isssue for 1847.[13]

Dr Ware wrote:

> 'I found on my arrival here, a new thing in the medical world, or rather, the new application of an old thing of which you will like to hear:- It is a mode of rendering patients insensible to the pain of surgical operations, by the inhalation of the strongest sulphuric aether [the Journal persisted in using the archaic spelling]. They are thrown into

a state nearly resembling that of complete intoxication from ardent spirits, or of narcotism from opium. The state continues but a few minutes - five to ten - but during it the patient is insensible to pain. A thigh has been amputated, a breast extirpated, teeth drawn without the slightest suffering. The number of operations, especially those in dentistry, has been very considerable, and I believe but few persons resist the influence of the agent .....'

The Journal then mentioned Bigelow's recommendations on the proper apparatus to use, recorded Liston's operations, and went on to report a number of individual cases from a variety of provincial centres.

It was therefore through the contacts of two Harvard professors with their friends in England that the information on ether anaesthesia became known in this country. By the summer of 1847, innumerable accounts of the use of ether as an agent to induce insensibility had been published in the journals. Yet if the *Lancet* may be deemed to have achieved priority in the originality of its reports, there was one issue of concern to the early pioneers that the Provincial Journal did first report. Many had considered the hazard that ether might be used for improper purposes. In the summer of 1847, the *Provincial Medical and Surgical Journal* published an account of 'Rape perpetrated on a female while under the influence of ether'.[14] The alleged event took place in Paris.

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THE HISTORY OF ANAESTHESIA AND THE LAW

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Anaesthesia had its first brush with the law in March 1847, within a few months of the first administration of ether. Civil litigation was uncommon in any country until the 1940s, and has escalated dramatically in the last 20 years. Criminal prosecution of doctors is rare, but an alarmingly high proportion of doctors convicted of manslaughter have been anaesthetists and, unlike those in other fields of medicine, none of these convictions has been reversed at appeal.

It is clearly impossible to review the entire history of anaesthesia and the law in a single article. Consequently, I have concentrated on the early encounters with Coroners, and with civil cases which I believe are important historically, or because of their impact on the practice of anaesthesia, or because of their impact on the law. In addition, I have reviewed briefly the history of criminal actions against anaesthetists, the most recent and potentially serious of which occurred in 1996, almost exactly 150 years after the first encounter between anaesthesia and the law.

The early Coroners' inquests - *The Grantham Inquest*

At 5.20 am on 11 March 1847, Mrs Annie Parkinson, a hairdresser's wife from Grantham, died, having undergone resection of an osteosarcoma under ether anaesthesia two days earlier. Mrs Parkinson's death became known to Mr G Kewney, the Coroner, and an inquest took place (with amazing rapidity) two days later, on 13 March 1847.[1] Mr Kewney clearly regarded the matter seriously. In charging the jury, he made the following remarks:

> 'The case you are about to investigate is one of the most important that it has fallen to my lot to preside over because, if it should be found .... that the death of this person did result from the effects of the vapour of ether, and not from the tumour under which she was labouring, or from the operation which was necessary to remove it, it will become a question, whether the person administering the ether is answerable for the consequences, or whether it is unsafe and prejudicial to life to pursue the practice of administering ether.'

> 'If, therefore, you should find that Mr Robbs has been guilty of culpable negligence, inattention or rashness, it will be your duty, as jurors ....., to bring in a verdict of manslaughter against him; but if .... you shall find .... that the death of Mrs Parkinson was purely the result of the application of ether ....., it will be your satisfactory duty to simply record that fact; and this inquiry may be the means of checking a practice that will then appear prejudicial to human life, and your labours may conduce, not only to the benefit of this immediate neighbourhood, but to the advantage of the public at large.'

Mr Robbs was a surgeon whom Mrs Parkinson had consulted about 15 months after first noticing a lump on the back of her left thigh. The lump continued to grow, until it became 'a great impediment to her walking sitting or sleeping'. Mr Robbs applied leeches to the tumour without success. Mrs Parkinson, who 'was what is called a very delicate woman, subject to cold upon the slightest occasion but was not consumptive', had seen several reports of

successful operations under the influence of ether. She decided that she wished the tumour to be excised, and it was agreed with Mr Robbs that the operation should take place under ether anaesthesia.

Two or three weeks before her operation, Mrs Parkinson had asked Mr Robbs what he thought of 'the application of ether'; he had told her that he 'had no faith in it'. However, he subsequently carried out an operation on a young man's toe with ether anaesthesia. The principal witness at the inquest was Mrs Elizabeth Leak, Mrs Parkinson's sister-in-law, and she told the inquest that she had spoken to the young man; he had said that, if he had to undergo another operation, he would 'take the ether'. Thus, apparently with the consent of Mrs Parkinson and her family, it was decided that the tumour should be excised under ether anaesthesia.

Perhaps because of his inexperience in the use of ether, Mr Robbs decided to test its effects on Mrs Parkinson. On 6 March he administered ether, in Mrs Leak's presence. The ether 'made her laugh very much, and whilst under its influence she was pinched very severely; and when she recovered from its influence she said she felt quite comfortable ...., but was aware she was being pinched, although she said it did not give her pain'. The administration of ether was repeated on 8 March, when Mrs Parkinson became unconscious and remained so for 15-20 minutes; upon recovery, Mrs Parkinson had said that she had been able to hear, but not to see.

The operation took place at about 1 pm on 9 March 1847. Mrs Leak was present, and told the inquest what she had seen. Mr Robbs performed the surgery, but three other doctors were present, and one of these, Mr Dibben, administered the ether. Interestingly, it was Mr Robbs, and not Mr Dibben, who faced the possibility of conviction for manslaughter at the inquest, because it was the decision to administer ether, rather than the method of its administration, which was in question. According to Mrs Leak, the ether was administered from a glass jar or globe through a tube made to fit the mouth. In about 10 minutes Mrs Parkinson became unconscious and was placed in the prone position. When the operation started, she 'made a deep moan', and more ether was given. Indeed, she moaned every time an incision was made, and 'appeared to feel it, as she struggled and nipped witness's (Mrs Leak's) hand; but she did not appear to feel anything when the vessels were being tied'. The entire procedure lasted about 55 minutes (Mr Robbs said later that the operation itself lasted 25 minutes, the remainder of the time being occupied by inhalation of ether and application of bandages).

Further details of the technique were revealed later.[2] The globe of ether was not placed in hot water, and was kept below the level of the patient. The pulse rate increased from 84 beats/minute before the inhalation of ether to 140 beats/minute during the inhalation. By the end of the procedure, the pulse was 'small and feeble'. Shortly before the end of the operation, Mrs Parkinson was given brandy and water 'which she swallowed readily'. At the end of the procedure she was put to bed, and given more brandy and water, and then a little gruel 'which she took, and said she felt better, but spoke in a very low and faint tone of voice'. On the following day, she 'remained in the same low state', but took medicine prescribed by Mr Robbs, together with a little thin gruel and tea. She complained of numbness in both legs and the lower part of her back. She told Mrs Leak that she had felt pain during the operation, when Mr Robbs cut her. At 5.20 am on 11 March, Mrs Parkinson died 'without uttering a groan'.

Another surgeon, William Eaton, performed a post-mortem examination. He told the inquest that the heart was 'more flabby or flaccid than usual and contained rather less blood than usual'. There was congestion of the membranes of the upper part of the anterior lobes of the brain, and 'there was no effusion in the ventricles'; these changes were attributed to the administration ether. It was Mr Eaton's opinion that death resulted from the administration of ether, not from the operation or the effects of the tumour. However, he indicated that the practice of administering ether had been 'sanctioned by the highest medical authorities', and he himself had administered ether to a patient who had recovered.

Mr Robbs gave evidence, and read accounts of numerous operations which had been conducted successfully using ether anaesthesia.

The jury concluded that Mrs Parkinson died from the effects of ether. At the end of the case, Mr Robbs stated that 'he fully concurred in the verdict, as he had no doubt whatever that the ether alone was the cause of death, and it was a duty he owed to the public to say so'. It seems to me that there is little evidence to incriminate ether, rather than the surgical procedure, as the cause of Mrs Parkinson's death.

The Winlaton inquest

Another inquest took place on 1 February 1848 at Winlaton, near Newcastle-upon-Tyne, following the death on 28 January of a 15-year-old girl, Hannah Greener. 'The case excited great interest.'[3] Hannah Greener had developed paronychia of the right great toe, and was advised by a surgeon, Mr Meggison, to have the toenail removed. The operation was performed under chloroform anaesthesia. Mr Meggison described the events in this way:

> 'I seated her in a chair, and put about a teaspoonful of chloroform into a tablecloth, and held it to her nose. After she had drawn her breath twice she pulled my hand down. In about half a minute I observed the muscles of the arm to become rigid, and her breathing a little quickened, but not stertorous. I had my hand on her pulse, which was natural, until the muscles became rigid. It then appeared somewhat weaker - not altered in frequency. I then told Mr Lloyd, my assistant, to begin the operation, which he did, and took the nail off. When the semi-circular incision was made, she gave a struggle or jerk, which I thought was from the chloroform not having taken sufficient effect. Her eyes were closed, and I opened them, and they remained open. Her mouth was open, and her lips and face blanched. When I opened her eyes they were congested.'

Mr Meggison splashed water in Hannah's face, with no effect, and gave her some brandy 'a little of which she swallowed with difficulty'; another witness said that, when the brandy was administered, Hannah 'rattled in her throat'. Mr Meggison then laid Hannah down and 'attempted to bleed her in the arm and the jugular vein, but only obtained about a spoonful'. the time between her first inhaling chloroform and her death was about three minutes.

Post-mortem examination by Sir John Fife, a surgeon from Newcastle-upon-Tyne, showed 'a very high state of congestion' of the lungs. The airways were filled with 'bloody froth'. In his opinion, death was due to congestion the lungs caused by inhalation of chloroform. The jury concluded that Hannah Greener 'died from congestion of the lungs, from the effects of

chloroform, and that no blame can be attached to Mr Meggison, surgeon, or to his assistant, Mr Lloyd'.

Civil litigation - *Negligence*

Probably the first civil case of negligence involving an anaesthetist was that of *Hillyer v Governors of St Bartholomew's Hospital* in 1909.[4] The patient had been anaesthetised for a medical examination. Three surgeons, an anaesthetist and three nurses were present. At the end of the procedure, the patient's arms were found to be burned, bruised and paralysed. It was accepted that these injuries resulted from negligent treatment, although it was not established how the injuries occurred, or which of the staff was responsible. However, the plaintiff, who sued the hospital, was unsuccessful because the institution was not held to be responsible for the actions of its staff.

Very little civil litigation took place against doctors in the first three decades of this century, most actions involving medical staff related to libel and to laymen masquerading as doctors.[5] The next major civil claim for negligence involving anaesthesia related to the death of James Henry William Collins from an inadvertent overdose of cocaine, which was administered in error.[6] Mr Collins was scheduled to undergo excision of the lower jaw under local anaesthesia on 20 April, 1945. On the evening before surgery, the surgeon telephoned his junior house surgeon, a lady who was not yet medically qualified, to give her instructions regarding the instruments which he would require to perform the operation, and asked her to obtain 100 ml of 1% procaine with 1:200,000 adrenaline from the pharmacy. Unfortunately, the house surgeon misheard him, and prescribed cocaine. The pharmacist did not query the prescription for this massive dose of cocaine, and dispensed the drug. Before the operation started, the surgeon was handed a syringe containing local anaesthetic solution. The house surgeon claimed that she had written the name of the drug on the syringe. However, the surgeon denied that there was anything written on the syringe, although he accepted that, because the theatre staff were accustomed to his requirements, he did not believe it necessary to obtain any verbal confirmation that the syringe contained procaine. He injected the contents of the syringe, and Mr Collins died. The surgeon, house surgeon and hospital were all found to have been negligent.

The principles propounded by the judge, Mr Justice McNair, in his directions to the jury in the case of *Bolam v Friern Hospital Management Committee*,[7] have become the cornerstone of the English test for establishing negligence against a medical practitioner, and have been adopted in many other countries. One of these principles, relating to conflicts between competing opinions of expert witnesses, is widely referred to as '*the Bolam principle*'. Although no anaesthetist was involved either in Mr Bolam's treatment or in the trial, an anaesthetic technique was at the heart of the dispute.

John Hector Bolam was admitted to Friern Hospital in 1954, suffering from depression. He was advised to undergo electroconvulsive therapy (ECT), and gave his consent. He received ECT on 19 August, and again on 23 August. On that second occasion, an initial shock was applied for one second, followed about four seconds later by five momentary shocks administered 'for the purpose of damping the amplitude of the jerking movements of the plaintiff's body'. During the procedure, Mr Bolam lay supine, with a pillow under his back. He had received an intravenous anaesthetic agent (administered by the psychiatrist), but no

muscle relaxant. He was not restrained in any way, although three male nurses stood around him, and would have caught him if he had fallen off the trolley. In the course of the treatment, Mr Bolam sustained dislocation of both hip joints, with fractures of the acetabulum on each side of the pelvis.

At the trial in 1957, it was alleged that Mr Bolam's treatment had been negligent because no muscle relaxant was employed and because he had not been restrained; it was alleged also that it was negligent to fail to warn him of the risk of fractures. Dr Randall, a consultant psychiatrist from St Thomas's and Charing Cross Hospitals in London, gave evidence for the plaintiff. He said that he had used a muscle relaxant drug routinely for ECTs since 1953 and that, since then, none of his patients had sustained a fracture. However, he accepted that not all practitioners had adopted this technique by 1954. Dr Marshall, the medical superintendant of Netherne Hospital, gave evidence for the defendants. He agreed that there was effectively no risk of fractures if a muscle relaxant drug was employed, but believed that there were other more serious risks, including death, which made the use of muscle relaxants undesirable as a routine. At Friern Hospital, muscle relaxants were used in selected cases (patients with a recent fracture, arthritis or a hernia). Evidence was given that, at Friern Hospital, eight patients had died in assocation with ECT, and at least five of the eight had been in patients in whom a muscle relaxant had been used. The probability of fracture in association with ECT without a relaxant was estimated at 1 in 10,000.

Mr Justice McNair directed the jury on two key issues: the degree of competence expected of a doctor in relation to the skill of the 'expert' and whether, in a situation in which there were two schools of thought, a doctor was negligent if he followed one rather than the other:

> 'The test is the standard of the ordinary skilled man exercising and professing to have that special skill. A man need not possess the highest expert skill at risk of being found negligent. It is well-established law that it is sufficient if he exercises the ordinary skill of an ordinary competent man exercising that particular art.'

> 'A doctor is not negligent if he is acting in accordance with a practice accepted as proper by a responsible body of medical men skilled in that particular art, merely because there is a body of opinion that takes a contrary view.'

This latter point has become known as '*the Bolam principle*'. The same principle was applied in 1959 in the case of *Moore v Lewisham Group Hospital Management Committee*.[8] A patient received spinal anaesthesia for cholecystectomy, but developed paralysis of the left leg after the operation. It was alleged that it was negligent to use spinal anaesthesia for this operation. However, there was conflicting expert evidence. The judge said:

> 'When there is more than one school of thought with competing techniques which have authoritative support a practitioner cannot be blamed for adopting either.'

Many patients are treated by trainee doctors. The case quoted most commonly in relation to the standard of care which patients should expect from trainee doctors is that of *Wilsher v Essex Area Health Authority*, which involved the development of retrolental fibroplasia in a neonate;[9] in this case, it was held that a hospital which failed to provide doctors of sufficient skill and experience, or to train these doctors adequately to undertake the tasks expected of

them, was directly liable in negligence, and that it was insufficient for the defendants to rely on the inexperience of trainees as an excuse for the development of a complication which would have been obvious to a more experienced practitioner. However, the same principle had been established 35 years earlier in the case of *Jones v Manchester Corporation and others.*[10]

William Jones was employed by Manchester Corporation and, on 11 January 1950, he sustained burns to his face as a result of an accident at work. He was admitted to hospital, where he was seen by Dr Olive Wilkes and Dr Sejrup, both of whom were house surgeons. Dr Wilkes had qualified as a doctor in 1949. She had (obviously) no qualifications in anaesthesia, and had little experience. Dr Sejrup had qualified in 1947. Drs Wilkes and Sejrup decided that they should clean up Mr Jones' face under general anaesthesia. Dr Sejrup told Dr Wilkes to administer nitrous oxide by face mask. She did so, but it then became apparent that the facial burns could not be treated with the face mask in place. It was decided that Dr Wilkes should administer thiopentone and remove the face mask. Ten millilitres of thiopentone (in an unspecified concentration) were given, and Mr Jones died. Although the initial claim was made against Manchester Corporation, Dr Wilkes and the Manchester Regional Hospital Board (but not Dr Sejrup) were joined as defendants. Dr Wilkes and the Hospital Board were found to have been negligent. The case went to the Court of Appeal on the question of whether the Hospital Board was liable for Dr Wilkes' actions. Lord Justice Denning made the following comment relating to the quality of care which a patient should expect from a trainee:

> 'The patient was entitled to receive all the care and skill which a fully qualified and well-experienced anaesthetist would possess and use. If Dr Wilkes failed to exercise that care and skill, she would be liable to the patient or his widow for the consequences.

The Woolley and Roe case[11] is probably the most famous medicolegal case in anaesthetic circles. It resulted in great controversy and was, alone, responsible for a great decline in the use of spinal anaesthesia in the United Kingdom for almost a quarter of a century. On Monday, 13 October, 1947, Dr J M Graham, a consultant anaesthetist in Chesterfield, anaesthetised three patients, all of whom received a spinal anaesthetic with hypobaric nupercaine. Cecil Roe, aged 45 years, was the first patient on the operating list, scheduled to undergo removal of a semilunar cartilage. The second patient underwent emergency laparotomy for intestinal obstruction; he died five days later from the effects of his illness. Albert Woolley, aged 56 years, was anaesthetised in the afternoon, for repair of a hydrocoele.

Following their operations, Roe and Woolley developed initially a flaccid paralysis of the legs, anaesthesia of the lower abdominal wall and legs, and incontinence of faeces and urine. Later, painful spastic paraparesis developed. Woolley was affected less severely than Roe, but both were greatly disabled. The third patient may[12] or may not[13] have developed neurological abnormalities before his death. The cause was alleged to have been leakage of phenol, in which the ampoules of nupercaine had been immersed to sterilise the exterior, through microscopic cracks in the glass, resulting in contamination of the local anaesthetic. This theory was put forward by Professor Robert Macintosh, acting for the plaintiffs, and was accepted by Drs Cope and Organe, the anaesthetic experts for the defendants. With the benefit of hindsight, this acquiescence on their part was perhaps tactical, as it offered a non-negligent cause of devastating neurological damage if it was accepted that a responsible

anaesthetist in 1947 could reasonably have been unaware of the potential for leakage through invisible cracks in glass. In the event, this was accepted, and Roe and Woolley received no compensation.

A number of interesting events occurred during the trial.[13] An eminent surgeon, Sir Hugh Griffiths, CBE, MS, FRCS, gave evidence for the defendants, and tried to explain to the court why he believed that phenol had not caused the neurological damage. Apparently, without the prior knowledge of his own counsel, he indicated that he had found 16 cases in the literature of phenol being injected into the subarachnoid space. It seems likely that he intended to show that the neurological damage which the plaintiffs had sustained was not consistent with the injection of phenol. This greatly upset his own counsel who, as indicated above, was probably much happier to run with the phenol theory, and rely on the expected knowledge of an anaesthetist in 1947 for the defence of the claims. Sir Hugh tried to refer to a report in the *Lancet*, dated 1931. The judge (Mr Justice McNair again) was impressed by this, and was keen to bring the author of the report to the court to give evidence. However, when it was disclosed that the author was a man with an Indian name who had treated the patients in Bangkok, he lost interest, and indicated that reference to published reports 'is not the right way of proving these experiments' (the tide has swung very much the other way since then, with judges tending to be much more impressed by expert witnesses who rely on published material than on their verbal evidence of their own experience). Sir Hugh thought that the nature of the metal used to make spinal needles was possibly the cause of neurological damage, noting that the incidence had decreased greatly since the introduction of stainless steel needles.

Sir Francis Walshe, OBE, MD, FRCP, FRS, a neurologist, also gave evidence for the defendants. He also rejected the phenol theory. It was his opinion that the neurological lesions were 'the result of a toxic or chemo-toxic action of the spinal anaesthetic upon nervous tissue'. When asked why it was that Woolley should develop neurological damage after receiving two previous spinal anaesthetics uneventfully, Sir Francis opined:

> 'I would say that the poor man was a pitcher that had gone once too often to the well. [This] means that you could tempt providence once too often.'

He was unimpressed by Professor Macintosh's evidence:

> 'The anaesthetist does not see a great many of these cases. He does not know the extent to which they occur. He never has to handle or deal with them, he has not that special skill by training to assess them.'

Dr Cope's account of the trial[13] suggests that the evidence of these two witnesses was ignored because of its manner of delivery and because it did not suit the defence counsel's case. In fact, both men were probably correct to suggest that phenol was not the cause. In a carefully reasoned argument,[12] Hutter has suggested that the cause of neurological damage was contamination of the needles and syringes by an acid descaler which had not been emptied from the water-boiling steriliser before the start of the operating list on the Monday morning.

The next major landmark in the interaction between anaesthesia and the law was probably the case of *Ackers v Wigan Health Authority*.[14] Mrs Ackers was paralysed but awake

throughout a Caesarean section in February 1981, and as a result suffered an illness of a psychiatric nature. Liability was admitted by the Health Authority, and the trial took place only to determine the extent of financial compensation to which she was entitled. The impact of the case resulted from extensive media coverage of Mrs Ackers' experience, and of the experiences of four other patients who were also aware during Caesarean section in the hands of the same anaesthetist. This resulted in a large number of 'retrospective' claims alleging awareness, in some cases many years earlier. Although adults are normally unable to initiate civil litigation more than three years after negligent treatment, most of these claims were accepted because the plaintiffs said that they did not know that awareness during anaesthesia could result from negligence until reading of Mrs Ackers' experience. The case is also of importance because it is one of the very few examples in which there is evidence that a medicolegal action has resulted in an improvement in clinical care of patients.[15]

Mrs Ackers was not the first patient to allege negligence related to awareness during anaesthesia. Mrs Jacobs sued Great Yarmouth and Waveney Health Authority alleging that she had been aware during hysterectomy performed in 1976.[16] The judge concluded that, although honest, her recollections were not accurate, and that she had remembered events before and after anaesthesia, transposing them in her mind to the intraoperative period; consequently, he found that the plaintiff had not proved negligence. This decision was upheld in the Court of Appeal, although the judges thought it just possible that Mrs Jacobs was 'one of those rare patients who reacted in an abnormal way to anaesthesia and, though paralysed, remained aware to a greater or lesser degree'.

Only four awareness cases have gone to trial on liability in the United Kingdom since Mrs Jacobs' case. In one of these,[17] it was concluded that, on the balance of probabilities, the patient's memories had occurred immediately after, and not during, anaesthesia. However, the judge, Mr Justice McKinnon, considered what his conclusion would have been if intraoperative awareness had occurred; this conclusion may have important implications in future cases of awareness:

> 'Even if the plaintiff's episode of awareness was during the operation, I entirely acquit [the anaesthetist] of negligence. As I find, she adopted a widely used technique of administering anaesthetics, a technique she carried out in a careful and competent manner. That technique carried with it a small statistical risk of awareness during the operation, a risk which arose from respectable and responsible medical opinion that halothane affected the contraction of the uterus after delivery of the baby.'

The standard of care expected of the anaesthetist was set out clearly; the anaesthetic technique must be one which is adopted widely, and must be administered with care and competence. If that technique carries predictable risks, and these risks occur despite careful administration, then the anaesthetist should not be considered negligent. The commonest reason for such a defence to fail is that, because of inadequate records, it is not possible to convince a court that the technique has been carried out carefully.

Trespass and assault

In the 1930s, an American car worker was trapped in a car on an automobile assembly line, and damaged his spine. He was treated by Dr Berg, a surgeon, and claimed that he told Dr

Berg: 'Don't do too much in my neck'. Dr Berg anaesthetised Mr Dicenzo before operating on him. He discovered that it was necessary to operate in the neck. The case is not well reported, but it seems likely that damage was done during the operation. Mr Dicenzo alleged that Dr Berg had treated him negligently, and with absence of authority. The jury disagreed, and decided that Mr Dicenzo had given sufficient consent to permit Dr Berg to operate as he deemed necessary after the patient lost consciousness.[18]

In December 1987, Mrs Joan Davis underwent a perineal operation under general anaesthesia. During anaesthesia, the anaesthetist performed a caudal block to provide postoperative pain relief. Mrs Davis awoke with persistent weakness in her left leg, and evidence of damage to the lumbar and sacral nerve roots, on the left side more than the right.[19] Although initially allegations of negligence were made regarding the conduct of the caudal block, these were abandoned during the trial, and submissions were made only on an allegation of assault, on the basis that (which was admitted) Mrs Davis had not consented specifically to the performance of caudal block. Mrs Davis' claim was unsuccessful. The judge, Mr Justice McCullough, expressed the opinion that, while there is a clear duty to explain, in broad terms, what is to be done, there is no obligation on doctors to explain in every detail what is proposed. The extent of the explanation was for the clinical judgement of the doctor, and in the event of a dispute the court should apply the *Bolam* test. In relation to anaesthesia, he expressed strong reservations about the introduction of 'sectionalised consent':

> 'If one is to treat the administration of an injection for analgesic purposes while the patient is generally anaesthetised as something requiring separate consent, why should separate consent not also be sought for an injection of, for example, morphine? If it is necessary to attach the patient to an electrocardiogram during surgery under general anaesthesia, ought not consent for that, too, be specifically sought?'
>
> 'How long will it be before the court is invited to say that separate consent should be sought for separate steps in the surgical procedure itself?'
>
> 'In my judgement, there is no realistic distinction between omitting to tell a patient that while she is under a general anaesthetic a tube will be put in her trachea and omitting to tell her that while she is under a general anaesthetic a needle will be put into her caudal region to provide postoperative analgesia.'

However, in a highly controversial decision by the Professional Conduct Committee of the General Medical Council in 1994, a consultant anaesthetist was found guilty of assault for inserting a suppository during general anaesthesia without obtaining specific consent from the patient.[20] The patient, a 22-year old woman, attended a dental surgery for extraction of two wisdom teeth under general anaesthesia. During the procedure, the anaesthetist loosened the patient's clothes and, in the presence of the dentist and two female dental assistants, inserted the suppository with the intention of providing postoperative pain relief. The suppository was inserted inadvertently into the vagina, and the patient, when she awoke, suspected that she might have been sexually assaulted. She reported the matter to the police, who rapidly concluded that there was no question of sexual assault. However, a report was sent to the General Medical Council, which charged the anaesthetist with failure to obtain valid informed consent, and thus with assault. These charges were upheld, and the doctor

found guilty of serious professional misconduct, despite the fact that a number of expert witnesses said that the anaesthetist's conduct mirrored their own.

The issue of consent in relation to anaesthesia is probably the most contentious of all at the present time.

Libel

In 1969, Mr S L Drummond-Jackson, a dentist of Wimpole Street, brought a libel action against the *British Medical Journal* and four of its contributors. The hearing started on 10 June 1972, and the action was discontinued on 31 October having exceeded in duration any previous libel action in the United Kingdom, despite the fact that the plaintiff's case was still unfinished and the defendant's case was not expected to start until February 1973.[21] Mr Drummond-Jackson had described a technique for administration of repeated doses of methohexitone, without local anaesthesia, for conservative dentistry. The technique became popular among dentists. However, in 1969, a study conducted in Birmingham was published,[22] with an accompanying editorial, criticising the technique because it resulted in fluctuating levels of consciousness, loss of integrity of both the respiratory and cardiovascular reflexes and, in some patients, an appreciable degree of hypoxia (findings later confirmed by other studies). At stake was the ability of scientific journals to publish the results of clinical research, even though these results might contradict those of others. The final result was that the defendants all recognised that Mr Drummond-Jackson was a man of the highest integrity and skill, while the plaintiff withdrew all allegations against the defendants of dishonesty or impropriety.

Criminal proceedings - *Manslaughter*

Three anaesthetists have been convicted of manslaughter in relation to their clinical activites in the United Kingdom, and all for errors which were considered to amount to 'gross negligence' or recklessness.

In 1959, a consultant anaesthetist was convicted of manslaughter following the death of a 2-year-old patient undergoing herniorrhaphy.[23] During the procedure, the surgeon noticed that the child was pulseless and apnoeic. The anaesthetist was found to be under the influence of anaesthetic drugs, and it transpired later that he was addicted to anaesthetic gases. He was sentenced to 12 months' imprisonment.

In 1990, two anaesthetists were convicted of manslaughter. In one case,[24] a locum anaesthetic registrar failed to detect disconnection of a mechanical ventilator for several minutes, resulting in the death of the 33-year-old patient; this case went to the Court of Appeal and to the House of Lords, where the conviction was upheld. In the other,[25] a locum consultant anaesthetist connected a 55-year-old patient's trachea to a high pressure oxygen source, causing fatal barotrauma. Both anaesthetists were sentenced to 6 months' imprisonment, suspended for one year.

There have also been convictions of anaesthetists for manslaughter in other countries. The risk of conviction is highest in New Zealand, where the test for manslaughter is different from that in most other countries. At the end of an operation in New Zealand in September

1987, the patient started to bite the endotracheal tube, and experienced difficulty in breathing. The anaesthetist decided to inject doxapram (Dopram), which was accepted as a proper method of treatment. He took a box of ampoules from the top drawer of the anaesthetic drugs trolley; a label containing the word 'Dopram' was on the drawer. He injected the contents of one of the ampoules. The ampoule contained dopamine. Dopamine should not have been in the top drawer of the drugs trolley. In addition, the anaesthetist had arrived relatively recently from the United Kingdom, where the boxes and ampoules of doxapram and dopamine were presented differently. The anaesthetist accepted that he had administered the wrong drug, but explained that, as the situation was urgent, he had not had time to check the ampoule properly. He was convicted of manslaughter.

Whereas conviction for manslaughter in the United Kingdom requires a jury to find, beyond reasonable doubt, that the doctor was guilty of 'gross negligence', the Appeal Court in New Zealand reaffirmed the different position which had already been established in that country:[26]

> 'Although required to prove ordinary causative negligence beyond reasonable doubt, the Crown was not required to prove a high degree of negligence, or gross, or culpable, negligence in order to warrant a finding of manslaughter.'

In New Zealand, the degree of negligence is reflected in the sentence. In this case, the judge was satisfied that there were extenuating circumstances: the anaesthetist, although convicted of manslaughter, was discharged without sentence.

Murder

Four doctors have been convicted of murder in the United Kingdom;[27] none was an anaesthetist. However, at the end of 1996, almost exactly 150 years after the first encounter between anaesthesia and the law, an anaesthetist in the United Kingdom was formally charged with murder in connection with his clinical duties. At the time of writing, it is believed that the charge will not be pursued. The history of anaesthesia and the law continues to unfold.

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CELEBRATION OF THE 150th ANNIVERSARY OF THE FIRST USE OF ETHER ANAESTHETIC IN THE OLD WORLD

This meeting took place in Dumfries on 19 December 1996, the exact sesquicentennial of the event, with an audience of over 200 people.

Dr Tom Baillie from the Netherlands, previously an anaesthetist in Dumfries, spoke on: *From Boston to Dumfries - the first use of anaesthetic ether in the Old World.* He gave a vivid account of the excitements and frustrations of his extensive researches into the past, and I suspect that only those cooking the lunch were concerned about how long he overran his advertised time! He is too good a historian to make more claims than the evidence permits but everyone present must have been convinced that the meeting justified its title. The occasion also saw the launching of the second edition of Dr Baillie's book *The Dumfries Ether Diary.*

His talk was followed by an enthralling account of the introduction a century later of curare, by Dr Roy Humble from Canada, also previously of Dumfries, entitled: *The Flying Death - A Great Dream Comes True.*

The final talk was by Professor William Bowman of Glasgow on: *The Thrill of the Chase - the Joy of the Discovery.* In addressing himself primarily to the large group of students from Dumfries schools who were present, he made himself all the more understandable to those of us whose pharmacology is becoming rusty. He was then presented with a sample of curare more than 50 years old by Dr Humble and invited to investigate its potency.

The meeting was held in the Crichton Royal Hospital, one of the earliest hospitals for mental diseases. During the day we were able to browse in its beautifully displayed museum, a museum of much wider appeal than merely to those with an interest in the history of psychiatry. The local press, as well as both BBC and Scottish Television, gave suitable prominence to a most enjoyable occasion. I had no difficulty in occupying the next day visiting historical sites in and near Dumfries, the extreme cold being more than offset by the warmth of the Scottish hospitality amongst the colourful Christmas decorations.

Aileen K Adams

PRAGUE CELEBRATION OF THE 150th ANNIVERSARY OF ETHER

On 16 October 1996, more than 250 anaesthetists and surgeons attended a most interesting and successful meeting in the baroque church of St Simon and Judas, which today is the home of the Prague Symphonic Philharmonic Orchestra. It was in the adjoining infirmary that Celestin Opitz, on 7 February 1847, administered the first ether anaesthesia in Prague. A plaque commemorating this event was placed next to the entrance of the original apothecary's shop of the infirmary in October 1995.

The meeting, sponsored by Abbott, was opened by the Chairman of the Committee of History of Anaesthesia, Prof J Pokorný, and the President of the Czech Society of Anaesthesia, Intensive Care and Resuscitation (CSARIM), Dr K Cvachovec. The occasion was used to grant Honorary Membership of the JE Purkyne Medical Society to Dr B Dworacek for his contribution to the organisation of anaesthesiology in the former Czechoslovakia. As a trainee in 1959 at the WHO Anaesthesia Center, Dr Dworacek had been impressed by the work in Copenhagen in such areas as critical care (Bjørn Ibsen), resuscitation (H Ruben), toxicology (W Dam) and pain therapy (J Kirchhoff). On his return he initiated similar programmes in Czechoslovakia, including obligatory training in basic resuscitation at all schools.

The scientific session was preceded by a splendid musical intermezzo featuring Dvorák's Biblical songs. The first speaker Dr V Lemon analysed the difficulties of surgery before effective anaesthesia became available. Prof Pokorný's presentation reviewed the circumstances of Morton's demonstration, and the spread of the use of ether throughout the world. He recalled that Celestin Opitz (1810-1866) was a monk, a Master of Surgery, who became a medical doctor in 1854 following study in Vienna. After persuading the surgeon Dr F Hofmeister, he gave the first anaesthetic in Prague - 114 days after Morton's demonstration. By 24 April 1847 he had given an astonishing 186 ether anaesthetics. Dr D Miloschewski then reviewed the spread of regional anaesthesia in the Czech countries following Koller's report. As early as 1900, in qualifying for a lectureship at Charles University in Prague, the surgeon Prof R Jedlicka had presented a thesis 'On subarachnoidal injections and surgical spinal analgesia'. The final presentation was by Dr R Jedlicka, who analysed the progress of surgery in relation to advances in anaesthetic techniques.

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